PART 6.

PRICE

THE

ARTIST'S REPOSITORY;

OR,

Encyclopedia of the Fine Arts:

EXHIBITING THE PRINCIPLES,

AND

EXPLAINING THE PRACTICE,

IN ALL THEIR VARIOUS BRANCHES.

A Work calculated to instruct the Student, and to gratify the Professor. It contains the Principles of delineating the Human Figure, &c.; the Methods of preparing and using all Kinds of Colours: Instructions for Painting: Engraving, &c.: Essays on Sculpture, Perspective, Architecture, and Landscape:—with a variety of Information connected with the Arts, their Principles and Practice, in their various Manners and Branches; including upwards of

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ject is curious, and allied to this discourse, I shall be permitted to introduce.

" I cannot take leave of these Monuments," says he, " without mentioning a strange deception in their appearance at different distances; it may serve to give some idea of the height of these masses, which is not to be conveyed by any comparison.

" I have already said, that I set out, at midnight, from Gisé, with the Arabs, who were to conduct me to the Pyramids. We directed our route by keeping these prodigious edifices, which seemed like so many mountains, continually in view. Being arrived at a village, which had hid them a moment from our sight, they re-appeared, on leaving it, so large and so near, that I thought I could touch them. I was even desirous to alight, but the guides assured me they were still a full league off. In fact, we continued to ride on, near three quarters of an hour, at the end of which the (great) Pyramid seemed so much lessened, that I alighted from my horse, a hundred paces from it, as much surprised to find it no bigger, as I had been before at its enormous size. But I presently found it magnified again on my nearer approach; and these contrarieties in its appearance, made me curious to discover their cause. For this purpose, I removed to the distance of six hundred paces from the Pyramid, along the plain horizontal to its base; I then turned about, and this point of view giving me its greatest apparent size, I remarked, that at this distance, its perpendicular height filled the angle of the visual rays in such a manner, that, on a nearer approach, this same

angle, which I shall compare to the two legs of a compass, could only embrace a part of the object, and that at the distance of a hundred paces, I could only discover a third; to which the sensation I experienced must be attributed.

"It follows, from this observation, that every object which exceeds the chord of the two visual rays, appears greater, and that which does not fill them, appears less, than it really is. This principle might be usefully applied to public buildings, if the best point of sight were to regulate their proportions."

Let no sailor laugh at the ignorant land-man, who does not perceive a ship's real course; for the eye judges of objects by comparison, and calculates, as it were, the size and nature of those afar off, by those around it. Thus, houses, trees, &c. near us, furnish means of determining with respect to others of a similar kind at a distance, and we judge of them accordingly: but, in the course of a vessel at sea, having no adjacent objects by which to calculate, the unaccustomed eye is embarrassed and deceived: I remember to have paid great attention in this instance to no purpose. As it is on sea, I presume it may be on land; if in the sandy deserts of Arabia there be any spaces without others around them in contrary, or at least in different, directions, I very much doubt if the eye, not habituated to such perceptions, can distinguish a slope, whether rising or descending, from level ground.

That the eye may be deceived into an opinion contradictory to the demonstration of the other senses, seems

seems, when first mentioned, highly improbable; yet so I have known it. In mechanical instruments this is frequent; but other instances offer: in a ship a little way out at sea, whoever looks back will see the land diminish, and recede from him; it will appear to him (especially if the gale be steady, and the sea be smooth) as if he absolutely retained his situation, while the gentle breezes wafted the shore out of his sight: but that the fact is really otherwise needs no proof: the fallacy originates with the beholder himself.

In travelling the roads of England, at every mile, or half mile, either a change of direction in the road, a variety of prospect, or some other novelty, occurs, which diverts the *tædium* of the journey. On the Continent many of the highways are perfectly straight, and level, for six, eight, or more, miles together; they are planted with trees in great uniformity on each side, and, by order, the carriages travel on the *pavé*, which is in the middle; thus, to the traveller, cooped up in a chaise, they permit no prospect but directly along them. If we imagine ourselves just setting forward at one end of such a road, our first observations may probably commend it as a most noble vista! its regularity almost surprizing, and the sight of the cross at the further end, pleasing enough. We move on for half an hour, perhaps, tolerably contented, but on examination, the future distance seems as long as ever; the same vista, the same regularity, and the same cross at the further end, are exactly as discernable as at first: surprized by the appearance, we almost

believe we have stood still. Notwithstanding the *allons*, of the postillion; the *crick crack* of his knotted whip; the jerks of his massive jack-boots, and the rumble of the wheels on the *pavé*, at the end of a second half hour (I speak not of English travelling) we again examine, and again we seem to have advanced—nothing; for still the trees are uniform, as before, still the vista is perfect, still the regularity is the same, and still the cross at the further end is exactly as discernible as ever. If, when we have accomplished this patience-improving labour, fickle fortune should turn us into such another, good heavens! a quarter of a mile in it, will either bring on sleep, or convince us, in spite of conviction, that we have made no progress from our very commencement.

And pray what are the causes of these deceptive appearances, Mr. LECTURER? Those, LADIES and GENTLEMEN, I proceed to consider.

Whether animals have equal vanity and pride to man, in supposing themselves examples of perfection, I know not; but, I confess, it sometimes startles me to see some of our species very little acquainted with their own natural and personal imperfections; rather, while we freely acknowledge that our sense of sight is indeed noble and invaluable, let us remember that it is limited and imperfect; though our visual powers surpass "the mole's dim curtain," they equal not "the lynx's beam."

Beside the fatigue which naturally arises from perpetual contemplation of unvaried uniformity (which it will be granted, is very considerable) and

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which acts as one cause of visual deception, there is likewise a distance at which the powers of the human eye fail with respect to every object, so far at least that it ceases to afford pleasure to the inspector; and this distance is regulated by a ratio, correspondent to the magnitude of the object inspected. If angelic powers may scrutinize through various systems; those of man are confined by his nature, and by his situation, to a small horizon; if he ascend the highest mountain, if he emulate the wing of the eagle, yet his survey bears a diminutive proportion to the "ken of angels:" but if he stand on level ground, and use no artifice, narrow limits bound his view. This is not all; we have before explained the natural principles by which sight is performed; we now further remark, that objects, according to their magnitudes, occupy proportionate quantities of the rays admitted by the pupil, and of course proportionate spaces on the picture impressed on the retina. In other words, according to the angle under which they are seen, they impart ideas of their dimensions.

I need not *prove*, that every object apparently lessens as it recedes; that as it diminishes, we survey it with less pleasure; that we the less distinguish it, and particularize it from among others; that it therefore costs more pains to examine; that if it be composed of parts not very large, this examination is an anxious labour; now, if it lessen perpetually as it recedes, it is certain that at some determinate distance it will cease to be visible. It may be worth while, to enquire at what distance this takes place.

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The smallest angle under which, in general, we may view an object, is one minute; this angle gives for the greatest distance at which a strong eye may discern that object, about 3450 times its diameter: for instance, an object one foot in dimensions, becomes invisible at 3450 feet distance; and a man five feet in height, is precluded from our view at five times that number of feet, that is to say, at 5730 yards, or about three miles: This calculation is for common day light. Now, if we would take our visual powers at the utmost, we must select an opportunity when they are surrounded by obscurity, and the object inspected is surrounded by light, or is itself luminous; for instance, a light of one inch diameter is discernible by night at above ten times the distance, at which by day we could discern a foot diameter, consequently, vastly beyond its day-light vanishing station, which is little more than four hundred yards.

These principles elucidate the first part of the science of Perspective; which accounts for the diminution of objects: The cause of this, we have observed, is, the perpetual decrease of the angle under which they are seen, correspondent to the increase of their distance; the reason of this decrease, we have remarked, arises from the structure of the eye; and thus we have liberated the science from much of that universality with which some have incumbered it; by proving, that the primary principles and powers from which it originates, and by which it is directed (*i. e.* those of sight) are by no means to be considered as unlimited, or universal.

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This will be further apparent, if we reflect, that we are much more sensible of the variations which take place in an object at a small distance from us, than of those which may happen in one considerably removed: thus in the *first* hundred yards of distance of an object of one foot in dimensions, we distinctly perceive its diminution; but, if it was advanced from its vanishing station toward us, *two* hundred yards, or even much more, we should not trouble the eye to inspect it. I infer, from this remark, that to apply the rules of Perspective to remote subjects is nugatory, even on theoretic principles, as already stated; and if we proceed to consider the actual space of vision admitted by the pupil into the eye, we shall greatly confirm this remark. It is true, *omniscient* Providence has contrived that a certain sensation of vision should be felt by us, even from objects whose lateral situations are almost parallel to the eye; but, this is uncertain, confused, and indistinct: it serves indeed to direct us, to warn us of danger, and for many other important purposes; but it is too vague, and embarrassed, to afford just ground for principles, much less for application of principles to practice.

I apprehend, that, in direct vision, when we attentively inspect what is before us, we cannot be said to see on many degrees *sideways* from the horizontal, or strait, line, immediately issuing from, or passing up to, the center of the pupil. I deny not that we may discern, but I think that discernment is imperfect; consequently, that the very object which centrically opposes our sight, is most distinctly

distinctly seen by us; those on each side of it, are somewhat less seen (though perhaps to calculate the difference might be difficult): those on each side of them, still less; and so on, lessening in accuracy as the distance increases, till those remote from the center are disordered, and indeterminate.

If this be fact, of what use are perspective representations which extend to many degrees on each side of the center? is it not rather embarrassing the spectator to offer such? especially, when we well know, that by choosing a proper distance, we reduce the whole to comprehensibility. Who that designed to view St. Paul's Church, for instance, or any similar object of great magnitude, would advance close up to the pillars of the frontispiece? on the contrary, he would walk from the object, I say, from the church, till he had acquired a station properly distant from whence the eye might include the whole, within a few degrees of its central line of vision.

Thus, then, we have confined the truth of vision (consequently the truth and the art of Perspective) first of all, to the centre, and to a certain extent around it; secondly, to that distance from the spectator (looking forwards), at which it is worth while to apply the rules of vision: *i. e.* to the space more immediately adjacent to him, and to a small field of view, which he more accurately inspects. The rules of vision are useless, applied by compasses to distant mountains, to the parts of buildings very far off, or where no objects offer a gradation: A plain sky, a plain sea, are no subjects for Perspective: but, where the eye can most closely inspect,

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in forms to which it is moſt accuſtomed, under circumſtances to which it is moſt familiar, and with which it is beſt acquainted, there it is moſt eaſily deceived, and moſt effectually delighted by the deception.

It appears deſirable, that the effect we wiſh to produce, ſhould be well underſtood by us before we proceed to the means of producing it; and ſince in other reſpects Nature is the original, the model, the guide of Art, I ſee no reaſon why, on the ſubject of Perſpective, Geometry ſhould be permitted precedence; ſince her efforts ought to be directed, not to the ſurpaſſing, but to the imitation of the univerſal miſtreſs, and regulatrix.

We now therefore, recall our conſideration to the ſource of Perſpective appearances,—the conſtruction and natural powers of the human eye. We have already proved (I hope diſtinctly and clearly) that the diminution of objects is cauſed by the ſmallneſs of the angle under which they are ſeen, and this is one reaſon why diſtance renders them inviſible to us. Another cauſe equally powerful, though of a different nature, is, the various quality, and force, of the rays of light emitted by, or reflected from, objects in various ſituations, and at different diſtances.

It is evident, that an object near the eye, which, conſequently, occupies a great proportion of the rays received by the pupil, will poſſeſs a large ſpace on the retina; and the rays of light reflected from it (*ſhot* as it were) having paſſed through a leſs diſtance from the object to the eye, they will enter the eye in full force and vigour; whereas by the removal of this object to a ſtation further off, not only the quan-

tity of its rays is diminiſhed, but alſo their luſtre and vivacity; they become feeble, and dim. This is natural to its diſtant ſituation, conſidered ſimply in itſelf, and if we advert to the ſuperior advantages poſſeſſed by other objects remaining near the eye, we find, not only that they occupy on the retina much of the ſpace heretofore occupied by the former, but alſo, by the vivacity and ſtrength of the images they raiſe, they *outſhine*, ſo to term it, their diſtant friend; unleſs, indeed, as in the obſcurity of night, the nearer objects are dark, while the remote are ſtrongly enlightened.

I proceed now from natural cauſes, to thoſe which are adventitious; the principal of theſe is, the rarity, or the denſity, of that medium through which objects are ſeen. To prove theſe effects demonſtrably, I have only to requeſt your recollection, that in the late foggy weather you could ſee, ſcarcely further than you could feel; or, if the eye had ſtrength enough to diſcern objects immediately around it, thoſe at a little diſtance, were involved in uncertainty. The objects were in their places; in full proportion; and your viſual powers in vigour; but the groſs medium prevented their uſual perception. This is an extreme inſtance of what is perpetually occurring around us, in a lower degree.

The air is a very ſubtile and tranſparent fluid, and in a ſmall ſpace, or diſtance, has no perceivable effect in diſcolouring objects; but in objects very remote, we diſcover its power. A mountain at hand, is green, or brown, the ſame mountain ſeen from afar, is blue; from hill to hill may be clear, while the lower grounds (as affording moſt vapour) are confuſed; the upper part

part of the ſteeple of a great church, may be diſtinct, while the body of the ſame church, is ſcarcely viſible. This one great cauſe, branches out into numberleſs variations, producing effects correſponding to the ſeaſons, and the weather; to climates, and to regions. A certain Engliſh traveller in Spain tells us, (and the caſe is the ſame in other warm countries, in very clear weather) that the outlines of diſtant hills, trees, &c. are defined with ſurprizing accuracy, and ſharpneſs: elſewhere, this effect is reverſed, and the outlines of diſtant objects are mellowed, ſoftened, and rendered indeterminate.

Such are the natural principles of Perſpective, the diminution of objects, and the weakening of their power on the eye, by diſtance: theſe are ſo obvious as to be undeniable, yet are they ſo powerful as to controul the whole of Perſpective: if beſide this the obliquity, declination, or bearing of objects, their contours, and their forms be underſtood, the ſcience ſhould appear to be complete. This latter article will ſpeedily engage our attention, for having thus, briefly, noticed the leading principles of natural Perſpective, I proceed to offer a few hints in explanation of that foundation on which we mean to erect the ART OF PERSPECTIVE: we have already diſclaimed the univerſality of the powers, or of the application of this Art: I hope, therefore, that by taking up our ideas with modeſty, and moderation, we ſhall attain greater accuracy, and certitude, in what we attempt.

The ſeat of Perſpective is the Eye; one eye if you pleaſe; for it is undeniable, that by opening, or ſhutting, either eye, the poſition, and general appearance of an

object is changed: therefore, we regard only one eye in this buſineſs, and that eye we conſider as a point. A word more on this ſubject:—At a certain diſtance, the rays from each eye coincide, and unite, ſo as to anſwer the purpoſe of one eye, by tranſmitting to the mind one image only of the object inſpected; this remark will hereafter appear of importance; ſince, whoever places himſelf to view a picture nearer than this diſtance, contravenes the deſign of the Artiſt, whoſe calculation is intimately connected with this circumſtance.

As it would be perplexing to treat on points, or ſmall objects, when extenſive, and larger objects, are more diſtinct, I ſubmit the following principles to conſideration.

A plane is a ſurface; a mere ideal extended ſuperficies, having no thickneſs: this ſheet of card paper, is therefore almoſt a plane, but not quite; as having ſome ſubſtance. This drawing-board is almoſt a plane, but, for the ſame reaſon not altogether; however, it may ſerve to elucidate the nature of planes; excepting, that as planes are mere geometrical ideas, they may be ſuppoſed in any direction whatever; or any number of them may croſs each other at all points with facility; a facility to which mahogany has no pretenſions. Permit me however to call it a plane. Now for its application:

The direct central beam of the eye, whether we conſider it as a ray of light, iſſuing from the eye, or entering into the eye, is, in either caſe, (naturally) diametrically oppoſed to the horizon; in other words, the horizon is the height of the eye; I ſpeak of a fair

fair equable horizon. The courſe of rays ſhot from the eye, to the various parts of this horizon, is a level, a plane of rays. A fan ſpread open may illuſtrate this idea; the handle may denote the eye of a ſpectator; the circumference of the edge of the mount may repreſent the horizon, and the ſticks are a level or plane of rays iſſuing from the eye to the circumference: or they may be regarded as rays iſſuing from the horizon, and terminating in the pin or pivot, the center of the handle: this ſtatement is perhaps moſt conformable to Nature; but for purpoſes of Art, either ſuppoſition may be adopted by way of explanation.

As I wiſh to render this part of our ſubject clear and familiar, I ſhall remind you of what we all have obſerved, occaſionally, I might ſay conſtantly. In entering a houſe, at the level of the ſtreet, we ſuppoſe right before us is a flight of ſtairs: obſerve theſe ſtairs; of ſome, *i. e.* of the lower ones, we ſee the whole tread of the ſtair; of others, higher up in the flight, we ſee little or nothing of the tread; of others, higher ſtill, we ſee no part of the tread, but, if the front of the ſtair was away, we ſhould ſee *under* the tread of the ſtair. Now each of theſe ſtairs may be taken to repreſent a plane; but it is evident, that only one of them can be the true horizontal plane. If we proceed up this ſtair-caſe, we obſerve other planes preſenting themſelves to our view, and each of them in our progreſs, anſwering to the horizontal plane: our eye has traced this—up the ſtairs—to the floor of the landing place—to other ſtairs, ſtill higher—and ſo on. In this manner would the horizontal line correſpond to the height of our eye, were we to aſcend to the very top of

of St. Paul's Church; where, by means of this correſpondence, we ſhould enjoy a more extenſive proſpect. The ſame effect, *inverted*, would follow our deſcent: we ſhould firſt loſe ſight of what was lately our horizontal plane, and all things lying on it, would diſappear; the ſame effect would attend that which in ſucceſſion became our horizontal plane, till we came to the level of the ground itſelf; and the ground itſelf would alſo yield to this principle, if we had occaſion to deſcend ſtill lower, as into a kitchen, into a well, into a deep pit, or into a coal mine.

Again, the ground whereon a ſpectator ſtands, is a natural plane: now if we ſuppoſe a ſpectator to remain fixed, while all the ſpace from before him to the horizon, is gently raiſed up vertically, when it has riſen to the level of his eye, he will not be able any longer to diſcover objects ſituated upon it; they are precluded from his ſight, and, together with the ground plane itſelf, they form a mere line; or they vaniſh: it follows, that the line formed by the horizon, is the vaniſhing line to the ground plane. Or, change the ſuppoſition, and imagine the ground to maintain its ſtability, while a ſpectator deſcends; as he goes lower, and lower, the diſtance between the horizon and the ground diminiſhes, till at length theſe two planes appear to him to unite. But there is no need for imagining ſuch high aſcents, or ſuch deep deſcents; an inſtance at hand may aſſiſt in demonſtrating this principle.

On this drawing board, we ſee *now* from end to end; but as I elevate it (yet keeping it horizontal), when it is equal in height to the eye, we diſcern not any

any part of it, but its edge. Now, obſerve, that if the ground plane, were it produced, would vaniſh into the horizontal line, all leſſer planes lying, being, and ſituate, (as the lawyers ſay) on this ground plane, or rather forming parts of this ground plane, would vaniſh into the ſame line. But, although not thus produced, yet the ground plane (and conſequently all planes upon it) have a perpetual tendency, and inclination, toward the ſaid horizontal line, till at length they unite with it, and in appearance become a part of it.

If a plane lying on the ground follow the direction of that ground, *i. e.* if it lie ſtraight before the ſpectator, the point to which the ſides of a portion of it cut *direct* will tend, is, that which is ſtruck by the center beam, or ray, of the ſpectator's eye; it is, I ſay, the center of the horizontal line. But if this portion of a plane lying on the ground, be ſituate in an oblique direction with reſpect to the ſpectator, then that point on the horizontal line to which it apparently tends (*i. e.* its vaniſhing point) will be removed on that line, from the center, to one ſide of it, according to its obliquity. *e. gr.* If it is ten degrees oblique from the eye, its point of tendency will be ten degrees diſtant from the center, and ſo on.

As an example, I have, you ſee, laid this portion of a plane of card paper, obliquely on this plane of mahogany, (which repreſents the ground plane immediately before the ſpectator) but as the directions of the ſides of theſe two portions or planes do not agree, it is certain the lines they form, if prolonged, would never arrive at the ſame point in the horizon; but, according to the variation of the card paper, from the true

true point of the drawing-board, ſo will its vaniſhing point be removed on the horizontal line. But, pleaſe to obſerve, that while it remains on the drawing-board, it may wiſh in vain for any other line on which to vaniſh; the original plane has the abſolute power of directing it in this reſpect.

Thus, have we illuſtrated the nature of planes, of the horizontal line, and of its center, of the ground plane, and of vaniſhing lines and points. What has been ſaid, has related only to planes, in a horizontal poſition,—What muſt we do with vertical planes? The ſame principles anſwer this queſtion. Inſtead of ſuppoſing that, from the center beam, or ray, of a ſpectator's eye, a line is extended laterally, which, in conſequence, forms the horizon; we muſt ſuppoſe a line to be extended *perpendicularly*, above, and below, the center; then is its office with reſpect to vertical planes, the ſame as that of the horizontal line with reſpect to horizontal planes. I move this drawing-board (holding it vertically) along the edge of the table; when it arrives at the direct beam of the eye, it becomes in unity with the ſaid centrical vertical line; conſequently it appears a mere plane, or, it vaniſhes. And this portion of a card-paper plane, is, you ſee, directed by that to which it is affixed, ſo that although it will not vaniſh in the ſame point as the drawing-board (which now repreſents a portion of a vertical plane at the ſame elevation as the ſpectator's eye), yet it will vaniſh on the ſame line, in a point correſpondent to its obliquity in reſpect to its original plane.

As to vertical planes parallel to the ſpectator, I ſcarcely think them objects of explanation, after what has

has been said; the only perspectivity of which they are capable, being a diminution as they recede from the spectator; but if we suppose any objects pourtrayed upon them, these will preserve their regular stations; not only the perpendicular lines continue perpendicular, but the horizontal lines continue horizontal; and thus, a square, which in either of the planes we have treated of would become oblong, (I mean shorter on two sides than on the other two); or a circle, which would become elliptical, in a parallel vertical plane retain their forms;—a square though diminished continues to be a square, and a circle continues to be a circle.

Neither shall we at present, regard planes oblique to the horizontal, or to the vertical line, since such are also of a construction similar to those already described; and since in our future progress they may be attended to with advantage. Enough has been said for the present;—I am not addressing an auditory in academical trencher-caps, bonnets, and bands, but (a considerable part of it at least) in gauze caps, bonnets, and ribbons; who, I conceive, engage in these studies not intensely, though heartily; not as the business of life, but as a most agreeable relaxation, uniting pleasure with improvement; and, therefore, refer the subjects already treated to candid consideration. For similar reasons I have avoided all mathematical terms and expressions, that I possibly could, and have endeavoured to familiarize the whole: if I have succeeded according to my desire, we have suffered little loss in the absence of abstruse terms, and hard names; and have had little reason to regret the pompous into-

nations of AXIOM, THEOREM, COROLLARY, or, Q. E. D.

In looking down the regular and strait streets as we pass along this great city, we may observe, and appropriate to what has been our subject, the planes around us: the pavement is undeniably the ground plane; in that part of another street which crosses the end of the street down which we look, is the centre of the horizontal line: the fronts of the houses on each side of the street, form vertical planes; and as the ground plane, by its continual apparent rising, seems to seek a union with the horizontal line, so these vertical planes, by appearing to approach closer and closer, as their distance from the eye increases, appear perpetually to seek a union with the vertical line, and especially with the centre, or direct beam of vision which regulates the whole.

I conceive the whole science, and secret, of Perspective is now opened; whatever variations may happen, or indeed can be contrived, may be reduced ultimately to these principles: I shall therefore detain you but little longer, on this part of the subject, while I notice what, perhaps, may to some person or other, and at some time or other, prove of service, if not of importance.

From the nature of the visual rays, I infer, that the misfortune of a cast in the eye, arises from the obliquity, and declination, of the the centre beam of one eye caused by the unequal strength of the eyes, whereby one shoots, as it were its beams well, the other with infirmity; now as this is regulated very much

much by the situation of the nose, a gradual addition of some thin substance to that side of the nose next to the affected eye, would, I am persuaded, in time, direct the centre beam of that eye, from its false, to its true, direction.

To support what has been said on the nature of the angle under which objects are viewed, I appeal to all magnifying glasses, which act by extending the angle, and which may be considered as an eye in advance; and as counteracting that diminution of objects which is the basis of perspective.

I shall remark further, that if the bodily powers of man in some instances are exceeded by those of creatures of inferior rank in the creation, yet his mental abilities make him ample amends; of this, the subject of sight is a direct proof: since, however confined by nature, art has extended its powers immensely "beyond this visible diurnal sphere," Not only are the splendid luminaries from whence we derive light and heat, inspected by us, but other systems are explored, and other suns examined. Perspective has its uses too in the business, such at least was the opinion of that great philosopher HUYGENS, who, wishing to calculate the dimensions of a remote star, could only attain his object by *reversing* his telescope, and thereby reducing the sun to similar dimensions, as if placed at a similar distance; very justly, therefore may it be said, that this science is not confined to this terrestrial ball; its principles extend into ether itself, and its laws regulate the splendors of the celestial luminaries.

But with regard to ourselves, LADIES and GENTLE-

MEN, we are attending to perspective as to the principles of one of our faculties; and indeed, it seems to me so intimately connected with our natural faculties, and capacities, (those highly proper objects of our study) that I am sorry, when I meet with any person, who, though possessing the gift of sight, is ignorant of the principles of a science so very important, and invaluable.

OBSERVATIONS,

OBSERVATIONS,

Relating to the Examples given in the Plates, and which belong to the foregoing Diſcourſe.

ALTHOUGH geometry muſt not be permitted precedence of ſome of the general principles of perſpective, yet is an acquaintance with certain of its problems very uſeful to the ſtudent; principally for the following reaſons (1) becauſe, being formed by the compaſſes and ruler, they are mathematically exact; and therefore (2) They diſcover at a glance the difference between the ſame figure in geometrical proportion, and when ſeen in perſpective: as for inſtance, a ſquare, or a circle, is determinately different in its form and appearance. We ſhall therefore attend ſomewhat to the ſimple elementary figures of this ſcience, and to the readieſt methods of forming them, previous to rendering them in perſpective.

Theſe examples are alſo of uſe in reference to the ſtudy of architecture; ſince the forms of the parts of buildings, and their ornaments, are compoſed of figures, which the principles of geometry treat with the greateſt readineſs and correctneſs. In fact, neither architecture, nor ſculpture, can exiſt unaided by geometry; and all imitations of thoſe arts, by painting, &c. muſt be regulated by the ſame principles.

PLATE

PLATE I.

No. I. Two lines not parallel, produced till they meet, will form an *angle:* thus A and B are united at C, and form the angle ACB. N. B. An angle being generally denoted by three letters, the middle one ſhould always repreſent the angular point.

An angle is divided by ſetting one foot of the compaſſes on the angular point C, and ſtriking the arch DE: then from D and E, ſweeping EF, and DF; whoſe interſection divides the original angle, by a line drawn to C.

No. II. When a line ſtands erect on another line, it forms a *right angle*, as BAD: when it exceeds a right angle it becomes *obtuſe*, as BAC: when leſs than a right angle, it is termed *acute*, as BAE.

No. III. To divide a right line into two equal parts; ſet one foot of the compaſſes on the point A, and ſweep an arch above and below the line; then ſweep a ſimilar arch from the point B: their interſections united by a line, will mark the exact diviſion, as C.

No. IV. To raiſe a perpendicular from a given line: from any point as a center, as C, mark two equal diſtances A and B: from thence ſweep the arches AD, BD, a line uniting their interſection D with the original point C, will be the perpendicular required.

No. V. To let fall a perpendicular from A to a line beneath it: ſet one foot of the compaſſes in A, and ſtrike BC: biſect B and C by the ſweep BD, CD, (as before in No. I.), the interſection will be perpendicular to A.

No. VI. To raiſe a perpendicular at the end of a line as A. B: ſet one foot of the compaſſes in B, place the other foot any where towards C, then from C as a center, ſweep ABD: through A and C, draw a line till it interſects the circle at D, which will be perpendicular to B.

PLATE

PLATE II.

No. I. Between two points, as A and B, to find two other points ſituated directly between them, ſo that a line may be drawn from A to B with a ſhort ruler. From the points A and B, make the interſections C and D, then from the points C and D, make the interſections G and H, theſe two points G and H will be in the continued line A B.

No. II. To draw a right line which ſhall touch a circle at a given point. Let A, B, C, be the circle in whoſe circumference the given point is A: from the center D, rule through the point A, a line of ſufficient length, as E, to which at A, erect a perpendicular as F G, which prolonged through A to G, is the line required.

No. III. From a given point to draw a right line, which ſhall juſt touch a given circle. Let A be the point given, from which a tangent (juſt-touching line) is to be drawn to the circle D E F: from the center G, draw G A, divide this line into two equal parts at H; from H as a circle, deſcribe the ſemicircle G D A; then a line drawn from A through D, will be the tangent required.

No. IV. To divide a line into any number of equal parts. From one end as A, draw at pleaſure A D: from the other end B, draw a line parallel to A D, as B C; from A towards D, and from B towards C, ſet off a number of ſpaces, one leſs than the number deſired: then unite the firſt in A D, with the laſt in B C, and ſo on in progreſſion: their interſections with the original line will divide it into the number of parts required.

PLATE

PLATE III.

No. I. A plane ſurface, terminated by three right lines, is a *triangle:* if the three ſides are equal, it is an *equilateral triangle.* To form this figure, from A ſtrike A C, the length of A B; from B, ſtrike B C the ſame length: their interſection gives the third point C.

No. II. A plane terminated by four equal ſides, at equal angles, is a *ſquare.* To form a ſquare: erect A C, which terminate at the ſame length as A B; rule C D parallel to A B: and B D, parallel to A C.

No. III. To conſtruct a pentagon, firſt deſcribe the circle A B C, which biſect, by ruling the diameter A C; on the center D erect the perpendicular D B; divide the ſemidiameter D C in E, which rule to B, and carry the interval E B to F: the diſtance B F, is one fifth part of the circle A B C. Any ſide of this pentagon biſected, gives the proportion for a decagon, as *a.*

No. IV. To conſtruct a hexagon, or figure of ſix ſides: firſt deſcribe the circle A B E D C F, which biſect by ruling the diameter F E: from the points F and E, with the ſame opening of the compaſſes as was uſed in ſtriking the circle, ſtrike the intervals A C and B D, which will give the points for conſtructing the figure. Any ſide of a hexagon biſected, gives the proportions of a dodecagon, as *a.*

No. V. To conſtruct a heptagon, or figure of ſeven ſides: firſt deſcribe the circle A B, which biſect in its diameter, as A B: with the interval of its diameter form the equilateral triangle A B C; then from one of its angles as B, rule the right line B 7 of ſufficient length; upon which ſet off the number of ſides (as 7) of which the figure deſired is to conſiſt: rule 7 A, then take two of theſe parts, as 7 5, and from the point 5 carry 5 D parallel to 7 A, ſtriking the diameter of the circle in C D; then from C, the higher angle of the triangle A B C, rule C D, which ſtriking the circle in E, will give A E for one ſeventh part of its circumference: carry this interval round the circle to complete the figure.

N. B. This method is general, for a polygon of any number of ſides: but, it is to be obſerved, that many polygons, which are near enough for practice, will not ſtand the teſt of mathematical exactneſs.

PLATE

PLATE IV.

No. I. To deſcribe a circle within a triangle: Biſect the angle B A C and C A B, by the method ſhewn in Plate I. No. I. The interſection of theſe lines in the middle of the triangle, gives the center, as D; from which a circle may be drawn, touching the triangle on its internal ſides. By opening the compaſſes from D to A, B, or C, we may inſcribe a circle around the triangle, touching its extreme angles, A B C.

No. II. To deſcribe a ſquare within a ſquare. Of the ſquare A, B, C, D, unite the oppoſite angles, A C and B D; biſect theſe, as A D in E; draw E F and H G parallel to A C: E H, and F G parallel to B D, to complete the figure.

It is evident, that to inſcribe a circle within the ſquare A B C D, the opening of the compaſſes from the central interſection O to E, gives the diameter; as the opening from O to A, to B, C, or D, gives the diameter of a circle around the original ſquare.

No. III. To inſcribe a circle through any three given points, as A B C: unite them by lines drawn to each, biſect the lines thus drawn, by perpendiculars, whoſe interſection denotes the center D, from which a circle may be drawn through A B C.

No. IV. To find the center of a circle: rule at pleaſure a line touching at each end the circumference, as A B; on A B erect a perpendicular as C, then biſect ſo much of C as is contained in the circle, which will give the center D.

No. V. The readieſt way to form an oval, is by ſtriking two ſmall circles, (one at each end of a right line, as *a b*,) their interſections denote the centers from whence to ſtrike the oppoſite ſides to complete the figure: thus, from *c*, with the interval *c* A, ſtrike A B, and from *d* ſtrike D C.

PLATE V.

No. I. Another method of forming a heptagon, or figure of ſeven ſides. Having deſcribed the circle ABC; with the interval EB, the ſemidiameter of the circle, ſtrike a ſemicircle, as from A to C, unite E and B, which biſects the line AC at D, the interval AD or DC, will be nearly one ſeventh part of the circumference: near enough for practice.

No. II. To deſcribe an enneagon, or figure of nine ſides. Beſide the general method which ſerves for polygons of any number of ſides already given, we ſhall add another way of forming a nine-ſided figure. Firſt deſcribe the circle ABC, then with the ſame opening of the compaſſes, deſcribe the arc AC as from B, unite AC, alſo BD; from C deſcribe an arc, as EF, and from E, deſcribe an arc to cut it at F; rule DF to this interſection, cutting the circle in *a*: the interval *a*C, carried round the circle, completes the figure.

No. III. To deſcribe an endecagon, or figure of eleven ſides. Having ſtruck the circle, draw the ſemidiameter as AB, which biſect at C; from B, with the interval BC, deſcribe the arc BD; and from C, deſcribe CD, ſtriking the circle in E; from E, with the interval ED, draw the ſmall ſemicircle *a*; unite C *a*, which carry round the circle.

No. IV. To deſcribe a ſpiral line. There are many kinds of ſpirals; ſome of which are of very complex operation; but this kind of ſpiral is formed by ruling a line acroſs the intended centers, as A*a*: from *a* ſtrike the upper ſemicircle, as A*b*; then remove the compaſſes to A, and ſtrike the lower ſemicircle, as *bd*; return now the compaſſes to *a*, and ſtrike the upper ſemicircle *d* to *e*: continue this proceſs as often as is requiſite. If a certain number of lines be required in a given ſpace, mark their diviſions on the croſs line *dbe*.

A ſcale for lengthening and ſhortening lines. Suppoſing the plane ſuperficies ABFE, had a number of lines inſcribed upon it, it is evident, that on the ſpace from A to B, the intervals 1, 2, 3, 4, 5, 6, are the ſhorteſt which can poſſibly be formed, &c. By ruling the angular line BC, theſe ſame intervals are lengthened on the line BC, in proportion to the angle adopted. In ruling BD, they are ſtill more enlarged; and in ruling BE, they are moſt of all enlarged; ſo that, the interval E1, is far longer than A1, and might be transferred to another ſcale, or to a ſubject for practice, as wanted. By the ſame manner *inverſely*, if BE was the length of the original line, a line ſet at the angle EBA, would receive the intervals; and would ſhorten them proportionately.

PLATE

PLATE VI.

To draw a line or lines, to a point given, which point is ſituated beyond the limits of the paper.

As it ſometimes happens, that a point to which it is required to draw lines, may be at ſome conſiderable diſtance from the ſubject with which thoſe lines are connected, a ready way to draw lines to ſuch a diſtant point is very uſeful.

No. I. Let AB and CD, be lines already drawn to P, which is a fixed point, it is required to draw from E, which lies between A and C, a line which alſo ſhall tend to P. Draw AC, at pleaſure, through the point E, then at ſome diſtance, draw BD, parallel to AC: rule the diagonal AD; draw EF, parallel to CD, and FG parallel to AB; unite E and G by a line, which if continued, would ſtrike the point P.

If the point from which it is required to draw the line, does not lie *between* two lines, but *beyond* them, as *a*, rule *a*A, and at a proper diſtance, rule *b*B; draw the diagonal AD*d*, then rule *ad*, parallel to CD, till it ſtrike the diagonal in *d*; from *d* rule backwards *db*, parallel to AB; then will *b* be a point, through which a line drawn from *a*, will tend to P.

By turning the paper, this point *a*, inſtead of being *above* the lines CD, &c. becomes *below* them: the proceſs is the ſame.

No. II. Another method of producing the ſame effect. Let AB, and CD, be lines given, tending to P. It is required to draw through the point E, ſituated between thoſe lines, a line which alſo ſhall tend to P: rule at pleaſure, two lines through E, as AG and FC: from A, rule through C, a line ſufficiently long; and from F, through G, rule another line, meeting the former in *a*: from *a*, draw *a*H, and *a*B, at pleaſure; draw the diagonals HD and BI, whoſe interſection gives K, for a point through which a line drawn from E will tend to P.

No. III. When the point, as *e*, is beyond the lines given. Draw *ea*, and *ef*, at pleaſure, cutting the original lines in *c*, *a*, *f* and *g*; draw the diagonals interſecting at *o*: draw alſo at pleaſure *bk*, ſufficiently long; at *d* where it cuts *ci*, rule *dh* through *o*; alſo rule *bi*, through *o*; from *h* draw through *i*, a line ſufficiently long; and from *b* through *d*, another line to interſect it; this interſection gives *k*, for a point, through which a line drawn from *e*, will, if continued, paſs on to P.—This figure alſo may be reverſed, by turning the paper; but the principles are the ſame.

PLATE VII.

To meaſure the Diſtance of INACCESSIBLE PLACES.

As occaſionally either curioſity or utility excites in us a wiſh to know the diſtances of places, when we cannot meaſure directly to them—beſides the amuſement which reſults from this, as a piece of geometry, we preſent in this plate two ſubjects for the purpoſe of aſcertaining the diſtance of a place which is inacceſſible.

Fig. 1. Suppoſe the ſpectator ſtationed at A, wiſhed to know the diſtance of the object B. At ſome little diſtance on one ſide A, as C, erect a ſmall ſtick; this being ſecured, retreat to D, obſerving that C covers the object B, whereby it appears that both are in one right line; here alſo erect another ſtick, then on the other ſide of A, at the ſame diſtance from A, as D is, and A alſo covering D, erect another ſtick E; then advancing to F, at the ſame diſtance from A as C is, place another ſtick, and continue advancing to ſuch a point (G,) that from thence A appears to cover B, and F appears to cover E: this point, G, is the ſame diſtance from A, as A is from B.

Fig. 2. But if it ſhould happen that this proceſs requires more room than can conveniently be engaged, this figure ſhews the mode of aſcertaining the diſtance in a place of ſmaller dimenſions.

The ſpectator being ſtationed at *a*, deſires to know his diſtance from *b*. On one ſide of *a*, as *c*, fix a ſtick; then advancing beyond *a*, toward *d*, fix on a ſpot which is ſome convenient number of times the length of *a c* (as three times) where alſo erect a ſtick: then fix on ſome convenient part of the line between *d b*, as *e*, and divide its diſtance from *a* into three parts (or ſo many as the line *a d* is divided into.) Set off one of theſe parts at *f*, taking care that a covers *e*; and advancing along the line *c f*, toward *g*, fix on that point from whence *a* covers *b*, and *f* covers *c*, (as *g*:) then meaſuring from *g* to *a*, it will be found one-third part of the diſtance from *a* to *b*: ſo that if from *g* to *a* be 100 yards, from *a* to *b* is 300 yards.

N. B. If the line *a d* was divided into four, or five parts, &c. then the line *a g* would be one fourth, or fifth, &c. of the diſtance *a b*.

PLATE

PLATE VIII.

TO ENLARGE, OR TO DIMINISH, AN OBJECT, *By Means of Squares.*

Divide the outer frame of the original, by any number of ſquares, at pleaſure; always taking care that they be exact: then, into preciſely the ſame number of ſquares, divide the ſpace allotted to the copy; the interſections of the lines will give ſo many points of certainty, that the forms of the objects repreſented may be procured with great correctneſs.

N. B. For greater accuracy it is beſt to number, and mark, the ſquares, that one may not be miſtaken for another. By this mode, a large picture may be reluced to the ſize of a drawing: or a drawing may be ransferred to a picture of any ſize whatever.

PLATE IX.

The ſtructure of the eye, is in fact, the ſource and origin of Perſpective, and all appearances of objects are regulated by it, and are conformed to its principles. We have therefore thought it adviſeable to explain in ſome degree, the nature and conſtruction of the human eye.

No. I. This figure repreſents the eye as a globe incloſed in its membranes, but having an aperture through which the rays of light paſs into it: the chief body of this globe is filled with a kind of gelid humour, whoſe convergent powers are not very ſtrong: but nearer to the orifice whereat the light enters, is a kind of lens, whoſe convergent powers are conſiderable, and this is of principal uſe in producing correct viſion.

This figure is meant to ſhew that the rays of light, which by paſſing through theſe humours, produce viſion, are directed to oppoſite parts of the eye from thoſe at which they enter, ſo that A above is depicted on the *retina* (which lines the inner cavity of the eye, and is the immediate ſeat of viſion) in *a* below; B at *b*, C at *c*; D at *d*, and E below, at *e* above; only the center C retaining its original direction: it follows, that objects are depicted on the *retina* inverſely.

No. II. This figure ſhews alſo that objects are depicted inverſely; at the ſame time it hints at the nature of that converging power which the humours of the eye poſſeſs, whereby the rays of light are directed preciſely to reach the *retina*, and neither to exceed the diſtance of that membrane, nor to fall ſhort of it. The proportion of theſe powers we ſhall ſee in another plate.

No. III. Shews the nature, and cauſes, of the apparent diminution of objects. We obſerve, that A A occupies on the circle of the retina, a much greater portion (as *a a* on the line *a a*) than B B does, which only occupies the ſpace *b b*, cutting off a ſpace on the ſmaller line *a a*, proportionate to ſo much of the line A A, as is cut off by the line B B. On the ſame principle C C is narrower (as *c c*,) than B B; and as C C occupies but a ſmall portion of the line A A, ſo it occupies but a ſmall portion of the circle of the eye, or of the line *a a*. This is one reaſon why diſtant objects appear fainter than thoſe which are at hand: but other reaſons are given in the lecture.

No. IV. Is an inſtance of ocular deception; but in ſome reſpects rather artificial, than natural; it repreſents a veſſel containing a piece of money, ſo placed at the bottom of it, that the eye cannot perceive it, becauſe its beams ſhoot over it: to render it viſible to the eye preſerving its ſtation, the veſſel is filled with water, the refraction of the rays in the water enables the eye to diſcover it. Many deceptions of the eye are practiſed by glaſſes, &c. in optics; but they do not properly belong to the nature of perſpective, though they flow from ſimilar principles.

PLATE

PLATE X.

This example exhibits the nature of a cone of rays, as iſſuing from an object to the eye of a ſpectator: if a tranſparent medium or glaſs were ſuppoſed to be ſituated between his eye and the object; it is evident that the point where any ray interſected that medium or glaſs, would repreſent to the eye a correſpondent point of the original object: and if the whole number of rays were thus deſcribed on the glaſs, they would form a picture of the object; correſponding exactly to its dimenſions, and figure, and having the ſame effect to the view of the ſpectator.

Now this is the very eſſence of PERSPECTIVE; to compoſe a picture, drawing, or repreſentation, which, though delineated on canvaſs, paper, or wood, &c. yet, ſhould convey to the beholder, as clear, accurate, and correct, ideas of the ſubjects deſigned, as if they were ſeen through a glaſs, or other tranſparent medium. To accompliſh this, we muſt not truſt to the accuracy of the eye, its recollections of the nature of lines, and forms, and their correſpondencies to each other, but muſt by ſtrict analyſis, examine the truth of their appearances, and underſtand the cauſes, the effects, and the applications of their principles.

PLATE XI.

No. I. Is explanatory of the ſeveral refractions of the rays of light, in order to their acquiring a true and exact focus.

The outer coat of the eye is termed the *ſclerotica;* adjoining is the *choroides,* which is lined by the *retina.* B *c d* B, is the tranſparent part of the ſclerotica, called the *cornea;* between which and C C (the *cryſtalline humor)* is placed the *aqueous humor.* D D the *vitreous humor,* occupying the remaining internal ſpace of the eye. N the *optic nerve,* inſerted laterally, leading to the brain. *o o* the pupil.

A is a ray which, ſtriking the eye preciſely centrally, needs no refraction in its paſſage to the bottom of the eye.

b, is a ray, ſtriking the eye in *d* (the cornea), whoſe refractive powers would divert it from the direct courſe, to a focus beyond the extent of the eye (as F 1,) were no other medium interpoſed: but, in paſſing to F 1, it impinges on (C C) the cryſtalline humor; and by this is again converged to a nearer focus (F 2): but as this is alſo beyond the limits of the organ, it is, in paſſing out of C C into the vitreous humor, again converged, and falls exactly on the nervous expanſion of the retina, at a third focus (F 3); there producing perfect viſion.

No. II. It is neceſſary to premiſe, that in explaining the following examples, the terms *perpendicular* and *horizontal* have no relation to the natural horizon, but relate ſolely to the poſition of lines with reſpect to each other: thus the line I C is perpendicular (i. e. at right angles) to the line C *b.* Theſe figures likewiſe explain many of the terms adopted in treating on perſpective.

In this example, the upright plane is ſuppoſed tranſparent, and the eye to be ſituated at I; a line drawn direct from I, to the plane (or picture) ſtrikes it in C; which is therefore the Center. From I to C is termed the *diſtance* of the picture: and is the juſt diſtance at which a ſpectator ſhould ſurvey the picture. The queſtion is, in what part of the picture the eye (I) will perceive the point A? To determine this, the point A is united to the bottom (or ground line) of the picture, by a line parallel to I C; where it interſects the picture, at the ground line, is termed its *ſeat* on the picture; the ſeat on the picture being united by a line to the center C (i. e. its vaniſhing point,) it follows, that in ſome part of this line will be the repreſentation of A: the exact place is found, by uniting I and A, which give the interſection *a* for the true ſituation of A on the picture to the eye placed at I.

No. III. Is exactly the ſame example diverſified by a point on each ſide A, which worked by the former proceſs, gives for 1 A 2, the repreſentation 1 *a* 2.

PLATE

PLATE XII.

No. I. Instead of the points being placed on each side to form a line, in this example, the line is formed *forward*. The representation is equally found by obtaining its seat on the picture, and uniting it to its vanishing point; then drawing A I, B I, to determine its perspective length, as *a b*.

No. II. Is a curious problem, shewing the imperfection of the art of perspective, geometrically considered. Every thing standing as in No. I. it appears by this figure, that the representation *a b* (of A B) *may* likewise be the representation of any line in any direction, whose extremes will give the points *a b*. Thus A 1. A 2. or A 3. may equally appear to I, to be A B. This being evident, it may be asked, how then do we determine with respect to the real forms of objects? The reason is partly because by perpetual use the mind acquires the habit of judging, and comparing objects with each other; and partly because the effect of light and shadow decides the matter. This figure may illustrate the supposition of undistinguished slopes in the Desart of Arabia, and seems to confirm the idea.

No. III. Is intended to shew, that when the plane wherein any object is situated is parallel to the picture, the representation of the object will be parallel to the original, and will exactly follow it: as appears by *a b c d*, which when beheld by I, corresponds to A B C D.

PLATE XIII.

Is a section explanatory of the principles reasoned on in the Lecture. It represents the eye of a spectator at three differently elevated situations, I 1. I 2. I 3. The lines drawn from the various points of the objects to the eye, (I) shew, by the spaces they occupy on the upright line A O, immediately before the eye, in what proportion the eye discerns the parts of such objects.

To I 1, the slope A B appears not much larger than the small space B C: C D is totally unseen by it: as is great part of D E; E, F, and G, H, it sees distinctly; but H K is a mere line, and therefore its extent is not perceivable.

To I 2 many of the parts hardly discernible by I 1, are very distinct; and it has a view of H K; but does not see the top of the house, except as a line.

I 3 has yet greater advantages, which appear on inspection.

This example shews what is *possible* in perspective; not only horizontal, or vertical planes, may be delineated; but slopes both upward and downward when surrounded by objects whose directions are different; and which therefore afford a contrast.

If at any time the student doubts whether a certain part of his design may be seen from the station he has chosen for the eye; a similar section will decide the case.

PLATE XIV.

After the former example, which has shewn the nature of the horizontal plane, and the variations which occur by reason of different levels of the eye, this example, which proposes to explain the effects arising from different levels of the eye, in reference to vertical planes, will meet with little difficulty in being understood. We have here also supposed three different stations, at which the eye is placed: I 1. I 2. I 3.

I 1 sees the edge of the house A, as a mere line only; but beside having a clear inspection of the interval B D, he sees the side of the church also, as appears by the line C; this he sees in perspective, as appears by the interval C D. D E, he also sees, but not E F.

I 2 beside the view he has of A B, sees also the side of the house (B,) but then he does not see the interval C D, otherwise than as a line; neither does he see the interval E F.

I 3 has a considerable view of the side of the house B, though he cannot see C D; he also sees the side of the church E F, but has not so complete a view of F G, as I 2 has, or, especially as I 1 has.

These examples demonstrate the propriety of paying great attention to the choice of situation, from which objects are beheld: at the same time, they illustrate the nature, the power, and the application of planes.

LECTURE II.

LADIES AND GENTLEMEN,

NATURE is ever various in her operations and effects; but, that variety, however diffuse, or extended, is, nevertheless, the result of certain general and permanent principles, whose simplicity is accommodated to occasions as they rise, and whose application is always directed by utility, and by convenience.

Art is the imitator of nature, and is never so truly valuable and excellent, as when, like nature, its principles are few, simple, and facile; and their application general, certain, and evident. It will therefore be my endeavour at this opportunity, to introduce to your acquaintance, some of those elements of the PRACTICE OF PERSPECTIVE, whose utility is most extensive. Let us never forget, that our business in treating the natural appearances of objects, is not to surpass, or to vary, but to imitate them; and those are the most useful methods which to the readiest expedition, unite the happiest certainty.

I wish to suggest, preparatory to our proceeding to practice, that perhaps perspective may be further illustrated, if we consider it under two ideas, 1st, as DIRECT; 2dly, as REFLECTIVE. To explain myself, I beg you to consider, that, when you survey objects,

of

of what nature ſoever (whether a ſimple lawn, or an extenſive champain) they appear *before* you, if ſeen by you through a tranſparent medium, as a glaſs window; but, if you ſee them in a mirror, although their general effect is the ſame as before, and their veriſimility almoſt as deciſive, yet in ſome reſpects they differ. Before, they might be ſaid to be depicted on the window *through* which you ſaw them; now, they may be ſaid to be depicted on the mirror *in* which you ſee them: yet as a picture, they have the ſame forms, the ſame effects, the ſame proportions, and the ſame relations to each other. The ſlab which is under that looking-glaſs, demonſtrates this matter: in looking at the ſlab itſelf (which we term an original object) we obſerve, that, its front is, and appears to be, neareſt to us; whereas, in the glaſs, it appears fartheſt off. This lady's fan, which I lay open on the ſlab, appears in the original ſubject, to be ſituated, with the circular edge of the mount furtheſt from us, and the handle neareſt to us; but, in the glaſs, the mount ſeems to approach, and the handle to recede; correſpondent to this effect, you ſee the ornamental figures on the mount are inverted. This reflective quality, enables the mirror to exhibit a moſt perfect picture of ſurrounding objects; and, when objects thus exhibited are correſpondently ſimilar, the eye is hardly induced to acknowledge the deception. This ſquare tea caddy, whoſe four ſides are perfectly uniform, appears almoſt as tangible in the glaſs as on the ſlab; this round ball, is as evidently a round ball

in

in the glaſs, as in my hand; nor would you (were the effect of the light and ſhade ſuſpended) be ſenſible of any difference. Since then this reflective perſpective (ſhall I ſo call it?) is no leſs exact and determinate than the direct perſpective, and ſince it is abundantly more convenient in practice, for ſome kinds of ſubjects, it will hereafter become a principal object of our attention.

To render reflective perſpective equally exact as the direct, is no very difficult matter, ſo far as to anſwer our purpoſe: it depends on the introduction, the ſelection, and the ſituation of an object; for inſtance, if we wiſhed the glaſs to become a repreſentation, or picture, of the fan with the handle furtheſt from us and the circular mount neareſt to us, it is but reverſing its original ſituation, and we obtain our deſire: nevertheleſs, the figures on the mount are not brought into their juſt ſituation, but although relieved from their topſy-turvy ſtate, yet continue reverſed as to right and left; as alſo the letters or whatever writing is on the fan.

But our attention is now directed to the neceſſary preparatives for the practice of perſpective: among the firſt, and moſt important, is CONSIDERATION, and this is to be applied to ſeveral articles. If, as we have already ſtated, the natural horizon be the height of the eye, it needs little proof that the ſituation to be adopted for this principal line, is a ſubject of conſideration; this appears yet more ſtrongly, when we reflect, that, if the eye be placed too high, it raiſes the

the horizontal line proportionately above the juſt elevation at which we are accuſtomed to ſurvey objects, and at which others are ſuppoſed to view them; it treats us as if we were giants, or were exalted on ſtilts; and if we lower the horizon, none but dwarfs will thank us. In fact, as nature has proportioned us to the world about us, our beſt way is to conſult that moderation which is moſt general, and moſt convenient. Security is in the medium; avoiding extremes.

Moreover, as a piece of perſpective is a repreſentation of certain objects from a given ſtation, to which it is moſt intimately adapted, we ſhould (if it may be done) endeavour to accommodate the principles of a ſubject to the ſituation from whence it is moſt likely to be inſpected; ſince the nearer that ſituation may be brought to correſpond to the original ſtation, the nearer will the effect of the compoſition approach to veriſimility: this, therefore, is alſo to be conſidered. And, if in a picture intended for a certain place, in any apartment, an artiſt ſhould omit to obſerve on which ſide the light entered, and ſhould, therefore, caſt his ſhadows *toward* the window, and his lights *from* it, I ſhould think he ſtood in great need of the article to which we are attending, and that, to ſay no worſe, he was a very inconſiderate practitioner.

The infinite variety of caſes connected with theſe remarks, preclude the poſſibility of rules which may be generally adapted to them: but, on the laſt article of conſideration, which at this time I ſhall ſubmit to your

your candour, the Diſtance for which a picture is conſtructed, and from which it ſhould be viewed,—ſomewhat like rules, or an advance towards them, may be attained: it is, I ſay, poſſible to ſuggeſt regulations for the DISTANCE of the picture.

Perſpective ſuppoſes, that, objects may be ſituated ſo cloſe to a ſpectator, that he cannot ſee them; and, in fact, our daily practice toward objects of any conſiderable magnitude, juſtifies this ſuppoſition; ſince we conſtantly recede from ſuch objects, to a proper diſtance at which to view them, as obſerved on a former occaſion. An additional remark may confirm this idea.

I conceive it needs little proof, that the boundary of the ſpace of viſion, or of the rays received by the eye, is a circle; for ſince the orifice of the pupil is circular, it cannot well be otherwiſe. Now as the two outlines, or boundaries, of the viſual rays from the two eyes, at a little diſtance from the perſon, have preciſely the effect of one only; it appears clearly, that nature never intended any object, whoſe diameter is too large to be compriſed within the ſpace of that circle, ſhould be ſurveyed cloſer than that ſtation, which produces the effect of compounding theſe circles. In fact, the internal humors of the eye are obliged to aſſume a form different from their uſual one, when they wiſh to accommodate themſelves to the inſpection of objects introduced within this diſtance; which, perhaps after all, are uſually ſeen with one eye (the other becoming quieſcent), or are at leaſt, beſt ſeen with one eye only.

A ſimilar

A ſimilar mode of reaſoning greatly enforces the importance of this article in relation to ſubjects not ſo cloſely approximated, but of larger dimenſions, ſeen *directly forward*; and, if we advert to ſubjects ſeen *laterally*, we ſhall find, that by a bad diſtance, the confuſion of rays admitted ſideways into the eye is very much increaſed, and what "being remote from the center, is naturally diſordered and indeterminate," now becomes inſufferable.

Permit me by a familiar example to illuſtrate this matter. When two perſons ſtand converſing cloſe together, they naturally look at each other about the height of the eye, and, conſequently, ſee very little more of each other than the face; as is evident, from the neceſſity, if their converſation ſhould happen to have any reference to the foot, for a motion of the head to inſpect it: which motion of the head be it remembered, deranges totally the former ſyſtem of perſpective, as it changes entirely the field of view. But, if a perſon wiſhed to ſurvey another from head to foot, it would require a ſpace between them of at leaſt double the height of the beholder. And the ſame is true of latitude, as of altitude. It is certain, that if a very preciſe inſpection of every part was deſired, this diſtance is not calculated for that purpoſe, but, for a general, complete, view of a perſon's whole figure, this is the leaſt diſtance at which the angle of viſion could receive, and contain, ſuch an object.

To the choice of a judicious diſtance, which is a principal care of intelligent artiſts, the following hints may contribute.

If the center of the perſpective ſyſtem adopted in a compoſition be about the middle of a picture, the diſtance may be ſhorter than if it were at either ſide of the piece; ſince before objects become ſufficiently remote from the center to appear diſtorted, the picture ends: on the contrary, when the center is near one ſide of a picture, a longer diſtance will be moſt advantageous to objects ſituated further from it.

I do not ſee much difficulty in determining, geometrically, the diſtance requiſite, if what I lately offered be juſt; for, if to ſurvey a perſon five feet in height twice five feet is a neceſſary interval, to double the height of the eye in treating ſmaller ſubjects, or, by increaſing the diſtance, to ſuit the apparent dimenſions of principal objects in larger pieces, is no great trouble. But, unfortunately, geometry is an unaccommodating kind of ſcience, and very adheſive to principles it has once aſſumed; therefore I wiſh to leave the matter rather to judgment, than to geometry.

The general nature of a ſubject, the particular natures of objects introduced, the ſituation for which the performance is adapted, the ſource of its light, and the principal effect of its compoſition, are all ſo many varieties, againſt which there is no providing by rule: a miniature picture, is one thing; a ceiling piece, is another: that which well becomes a church, ill ſuits a cabinet: that which occupies half a pannel in a parlour, is certainly diſtinct from a viſta deception in a park; and requires no leſs diſtinction of management. But, having fixed the height of the eye, and having choſen a diſtance from whence the

the objects repreſented in the picture may be moſt conveniently ſeen, we proceed to prepare the picture for practice: by which, I mean nothing more than inſcribing upon it thoſe imaginary lines, to whoſe properties we have already paid ſome attention. *Firſt*, rule the horizontal line, then, having determined its center, erect there the vertical line; thus we have two lines, whereon all relative planes (*i. e.* horizontal or vertical) will vaniſh. Moreover, as all horizontal planes will vaniſh on the horizontal line, we have the proper vaniſhing point for them in the center; becauſe the vaniſhing point to any plane (in whatever direction) is that point at which a line drawn from the eye, parallel to that particular plane, ſtrikes the picture.

Obſerve further, that, theſe two planes are of neceſſity *perpendicular* to each other; I ſay the horizontal plane is perpendicular to the vertical plane, and the vertical plane to that: for as to the ſituation of this or of any plane, with reſpect to the natural horizon, let that now be forgot.

We have already obſerved, that planes are in fact of a ſimilar conſtruction, whatever be their poſition; and therefore the vertical plane is perfectly correſpondent in its conſtruction, and its properties to the horizontal, and differs only by ſituation, as being erect upon it. The center beam, or ray, from the eye, is parallel likewiſe to the vertical plane, and gives the central point of this plane for its vaniſhing point: *i. e.* where the horizontal and the vertical planes interſect each

other. To demonſtrate this, take any perſpective example, turn it, till the vertical plane becomes the horizontal plane, and you will ſee, evidently, that it is governed by the ſame center, and conducted by the ſame principles.

Thus far, I hope our principles are clear, and luminous; referring to the examples for certain inſtances of their application, I ſhall now offer a few remarks relative to the introduction, and the appearance, of objects repreſented in perſpective.

I think it moſt familiar to my auditory, to revert to the mirror, to illuſtrate this particular, as the reverſion of objects will hereafter appear to be of no real detriment, or conſequence: in fact, whenever geometrical plans of original objects are uſed (and on many occaſions they are to a learner very convenient), their perſpective repreſentations become reverſe; but ſuch plans are not always neceſſary, as, by the given dimenſions of objects, a maſter will generally aſcertain their repreſentations.—To proceed,

That upright looking-glaſs repreſents an upright picture; the ſlab before it, the ground; where the bottom of the glaſs touches the ſlab, is, of courſe, the ground line. I lay on the ſlab, this ſquare board, cloſe along the bottom of the glaſs, which, on looking into the glaſs, I ſee thus: the ſlab, and the board are *parallel* to the ray ſhot from the eye to the center, (or received by the eye into its center,) which ray is *perpendicular* to the glaſs. Now, as the center is the natural vaniſhing point of all lines perpendicular to the

the picture, the two perpendicular ſides of the board apparently tend to that point: *i. e.* the center; the neareſt part of the plane to the eye: the other two ſides of the ſquare being parallel to the picture (the glaſs in this experiment) ſuffer no change of form from any perſpectivity connected with them, except an apparent diminution of magnitude, as they recede: the moſt diſtant being the ſmalleſt. By the bye, this want of perſpectivity in the parallel ſides of a ſquare, obliges us to ſeek for ſome line which may have a determinate, and exact, relation to a ſquare, and alſo to the horizon; this we obtain, by means of the diagonals, whoſe angular declination from the ſides being 45 degrees, gives 45 degrees from the center, on the horizontal line, for their vaniſhing point; as is illuſtrated in the examples.

But, my chief deſign in this experiment is to ſhew, that the effects we have been noticing ariſe from the *paralleliſm* of the viſual rays and the ground plane. Now, in deſign, we cannot cauſe a variety of planes, and of lines, to *project* perpendicular from a picture; we therefore tranſpoſe their places, and imagine the eye and its ſyſtem of rays turned upward, and the ſlab, &c. (*i. e.* all before the ground line of a picture) turned downward; and this reſtores the paralleliſm, and produces the ſame effects; ſo that now a ſingle ſheet of paper contains the whole proceſs.

Right lines, having a regular, and determinate perſpective tendency, are eaſily put into perſpective repreſentation; and angular figures, being compoſed of right

right lines, have little difficulty; ſince we have accurate *data* to conduct us: but, circular, or curved, lines offer no ſuch data, and therefore oblige us to call in aſſiſtance from our worthy friends, whoſe tendency is regular and determinate.

A circle, is a figure ſo complete and perfect in itſelf, that it eludes every attempt to diſcover to what point in perſpective any part of its line has any peculiar relation: any relation of which we may take advantage: the readieſt way therefore to obtain the repreſentation of a circle, is, by inſcribing it in a ſquare of equal diameter, and, taking advantage of thoſe points wherein the two figures correſpond; hereby we obtain a ſketch, or ſkeleton, of the circle; which is capable of more, or leſs, accuracy, according to the diviſions, and ſub-diviſions, of the original ſquare. Eight points are generally thought ſufficient in practice; but more may eaſily be obtained, if the ſquare be large enough to render them neceſſary.

Nor on this occaſion only is a ſquare of great utility; a little conſideration will find it a very conſequential figure; as well, becauſe its form is perpetually occurring, (as is likewiſe a circle) as becauſe any other figure inſcribed within it, by properly ſubdividing the ſquare, may be repreſented with little trouble.

Having ſaid a ſquare, and a circle, are figures perpetually occurring, give me leave to authenticate my poſition. If we examine objects in the ſtreet;—the fronts of houſes are ſquare, their windows ſquare, their doors

doors ſquare;—churches the ſame; or at leaſt, ſquares combined with circles: their domes are circular, as are all arches, and ſo on. The internal parts of our dwellings are equally compoſed of ſquares;—apartments, and their furniture, tables, chairs, &c. moſtly ſquares: not only ſo, but many of our domeſtic ſquares generate circles, as for inſtance, all which turn upon hinges; the hinge becomes a center, while the door itſelf in opening deſcribes a circle on the floor: not only architectural columns are compoſitions of circles, but ſo are many other objects which might be named, even to tea-cups and ſaucers.

By a kind of analyſis ſimilar to this, we reduce a piece of perſpective to its firſt principles. Buildings, may be conſidered as right lines, or as compoſed of right lines, croſſed by other right lines at certain angles, and deſcribing ſolids, or apparent ſolids, either elevated on, or adjoining to, each other; and, extremes of lines are mere points.

By an inverſe proceſs we compoſe the whole; firſt, we find the perſpective ſituation of one point, then of another beyond it; theſe united make a line: in the ſame manner other lines are made; which attached to the former, by degrees become a ſolid: ſolids raiſed on each other, or adjoining to each other, compoſe buildings; whoſe extent, how large ſoever, is merely an addition of ſolids to ſolids, and parts to parts, ſo related, that, having adjuſted one part truly, the others are eaſily determined.

The almoſt irreſiſtible effect of regularity may be very juſtly inferred from hence; and not leſs juſtly, the

the neceſſity of a careful beginning, and an orderly progreſſion. Perſpective, in this reſpect, is an emblem of life; how many perſons have proceeded from a point to a line, and from lines to a ſuperſtructure, whoſe termination they did not foreſee, when the firſt line was ſuggeſted, or the firſt point conceded.

Since I have thus introduced analyſis, I ſhall requeſt your attention, LADIES and GENTLEMEN, to a few additional remarks. The perſpective, I have the honour to introduce to you, is founded on the doctrine of planes; and planes are in effect more univerſal than ſuperficial obſervation may imagine. We have already ſaid, they appear around us in the ſtreet, and ſo they do in the parlour; the ſides of a room are planes, as well as the ceiling, and the floor. What is this table but a plane? its face is a horizontal plane; as I let down a flap, that flap becomes an inclined plane; a door is an inclined vertical plane when partly open, though not diſtinguiſhed when ſhut; a chair becomes an inclined plane when falling; and if we go out of the room, the ſtairs are inclined planes, and ſo are ceilings above them; ſo are roofs of houſes, and ſo are all inequalities of hills and dales in the moſt extenſive proſpect.

Theſe principles will be more largely explained in the examples; which I beg you not to paſs over ſlightly, but to delineate with care. It has been my endeavour ſo to ſelect, and arrange them, that each naturally leads to its ſucceſſor; and that they might compoſe

compoſe a connected chain of precepts, in which a ſtudent may proceed gradually,

Thought following thought, and ſtep by ſtep led on——

I ſhall juſt hint, that it is not always neceſſary to have, on a drawing, every line to every point, at once; but, after thoſe relating to one object have been drawn with the pencil, and the requiſite parts inked in, the pencil lines may be diſmiſſed. In ſome caſes it is ſcarcely neceſſary to draw lines at all, but, by laying the edge of a ruler from point to point, ſo much of that line may be taken as occaſion requires.

Nor would I adviſe my friends to draw by the regular proceſs of perſpective, every minute particular in a compoſition, every ornament of a moulding, or every inequality of ſurface: the principal lines and ſpaces, if juſtly inſerted, will regulate the inferior; and trifling objects are not worth the time, and the trouble, they waſte. Be it always remembered, that the utility of perſpective is to deceive the eye of a ſpectator; and ſurely an eye and a hand accuſtomed to inſpect, and to operate, by judicious principles, whoſe intelligence ariſes from ſyſtematic knowledge, will be very adequate to ſuch deception; always ſuppoſing, that the objects in queſtion have been well underſtood, and that practice has imparted a facility in their delineation; and indeed, I may juſtly aſſert, that many objects are with more eaſe and readineſs delineated from their originals, by an accurate hand, than by the rules of perſpective; of which the capitals of

columns, especially of enriched, *e. gr.* of Corinthian columns, are decisive, but by no means singular instances.

As in the study of music, notwithstanding an instrument may be very accurately constructed, and very nicely toned, to excel in playing on it requires a good natural ear, improved by attention, and practice; so in the arts of design, of which perspective is a principal part, be the rules ever so judicious, clear, demonstrable, and extensive, yet to execute any composition happily, and gracefully, requires the guidance of an eye accustomed to observation and remark, exercised in effects of natural objects, sensible of their most beautiful combinations, and disposed, and ready, to imitate them: thus accomplished, it may justly hope, not only to apply with facility the principles of science and taste, but,

"To snatch a grace BEYOND THE RULES OF ART."

I have thrown out these hints, because I earnestly wish to divest this study of every incumbrance by which it has long been held, as it were, in thraldom; entangled by operose diagrams, and infinite radii of lines; whose perplexities contribute to render that difficult and complex, which is, and which ought to be, represented as simple and clear. I rather desire to disentangle, and to explain, difficulties, where difficulties must in some sense, be expected, in which undertaking I have to request your candour, and, if success crown my endeavours, I have to expect your applause.

OBSER-

OBSERVATIONS

On the Plates belonging to LECTURE II.

IN the following plates, it has been endeavoured to preſerve an uniformity of references and marks, in order to inform the ſtudent, at firſt ſight, which are the principal lines, and points, made uſe of in their conſtruction. Thus, I, means the place of the natural EYE, which is *tranſpoſed* according to the principles explained in the Lecture, page 57. HL is uſed to mark the HORIZONTAL LINE, C denotes the CENTER, or direct ray from the eye to the picture, and the bottom of each example is the ground line.

It is further to be noticed, that the DISTANCE is throughout theſe examples, generally, too ſhort, for objects ſituated *laterally*, in order to avoid the multiplication of plates; for the ſame reaſon, the examples are drawn on the horizontal plane, but it will be very advantageous to the ſtudent to turn them, and to accuſtom himſelf to view, and to delineate, them, in various poſitions, as their conſtruction is preciſely the ſame in all. By this method every example becomes as uſeful, as two, or three.

It is obvious to remark, that, all figures put into perſpective by means of geometrical plans are *reverſe* from their originals: this reverſion is eaſily accommodated to truth, by changing the poſition of the plan, by which means all confuſion is avoided. Perſpective plans may be formed without the geometrical figure, by given meaſures, and angles.

PLATE XV.

LINES IN PERSPECTIVE.

No. . This example ſhews the method of putting into perſpective a RIGHT LINE, as A B; or part of a right line, as A 1; or a ſimple point, as A. Having placed (H L) the horizontal line, and determined the center (C), and the diſtance (C I) I is the tranſpoſed place of the natural Eye. If A be conſidered as a point, unite it to the ground line, by a right line in any direction at pleaſure (as at B); rule from I, a line, parallel to this line, towards H L (as near L); then, the point where it ſtrikes H L, is the vaniſhing point to A B: unite B to this point by a line, in ſome part of which line will the repreſentation of A be found. To aſcertain its exact place on this line, unite A to I, the interſection of the two lines marks the ſpot as at *a*. It is evident, that the repreſentation of the line A 1 may be determined, by treating the point 1 as we have already treated the point A; which will give its ſeat on the line B L at 2. The repreſentation of the whole line A B, which is B, 2, *a*, is equally readily found, as appears by the figure.

The direction of the original line, drawn from the point A, to the ground line, is of no conſequence, or effect; in every direction its parallel from I muſt be drawn to H L.

No. II. Is a variation from the former example, by ſuppoſing the original line to be *perpendicular* to the picture. The principal ſyſtematic lines are as before. In this caſe, as the line A B, or the line D E, would naturally vaniſh in C (which is its parallel), we are concerned only to determine its length; this is obtained, in A B, by uniting A and I, the interſection gives B *a* for the length of B A: but, as D E, if united to I, yet continues a mere line, we muſt find other lines by whoſe aſſiſtance to cut off its proportion: unite E to the ground line, by a line in any direction, as *c*; and by a parallel line unite D as *d*; then, by a parallel from I to H L we obtain a point, to which, when the interſections *e* and *d* on the ground line, are united, they give *f g* for the repreſentation of D E the original line.

PLATE

PLATE XVI.

No. I. A SQUARE is a figure compoſed of four ſides; two perpendicular to the other two: if a ſquare be ſituated with two ſides parallel to the picture, it is evident the two other ſides will be perpendicular to that picture: theſe may be conſidered as two lines, placed as in the foregoing example, which naturally vaniſh in C, to which therefore unite them: to determine their lengths as ſeen in perſpective, rule a diagonal line from the oppoſite corners of the original ſquare, which line unite to the ground line; rule its parallel from I to H L, and unite its ſeat on the ground line to that point in H L ſo procured; its interſections, will cut one line of the two drawn to C, in its neareſt part, and will cut the other line, in its furtheſt part: from theſe interſections, lines parallel to H L will complete the figure. *Ex. gr.* A, B, D, E, is an original ſquare; produce A D, and B E, to the ground line, as, 1, 2, theſe vaniſh in C; produce alſo E A, to the ground line, this vaniſhes in its parallel I L, and gives *a d b e* for the repreſentation of the original ſquare, A, D, B, E.

N. B. The diagonal of a ſquare being naturally 45 degrees, if an angle of 45 degrees be made from I and continued to H L (as at H), it will give H for the vaniſhing point of ſuch a line; without the neceſſity of recurring to the lines of the original figure.

No. II. Repreſents a ſquare lying *obliquely* to the picture: continue the ſides E B, E D, to the ground line, as 1 2, and alſo the ſides D A, B A; as 3, 4: find the vaniſhing points on H L, by lines from I, parallel to E B, and to E D; the ſeats on the ground line (1, 2) of the original figure, united to thoſe points, give *a b d e* for its repreſentation.

PLATE

PLATE XVII.

No. I. Is a TRIANGLE in perſpective: its repreſentation is obtained, by uniting two of its ſides, D B, and A B, to the ground line, as 1, 2; lines parallel to theſe originals, drawn from I to H L, give the vaniſhing points of thoſe two ſides; to which points, rule their interſections on the ground line, which give *b*, *d*, for their length; a line parallel to H L, uniting theſe interſections, completes the figure, and gives *a*, *d*, for the repreſentation of A D. The veracity of this proceſs is *proved*, by uniting D and A to I, which equally give the points *a*, *d*.

On this plate and the foregoing, the reader will obſerve ſlightly marked figures of like nature with the principal; ſhewing how to adjuſt a ſeries, as of ſquares, &c. forming for inſtance, a pavement. This is accompliſhed by uſing the dimenſions of the perſpective repreſentation already obtained, as a ſcale, and marking them on a horizontal line, level with ſuch repreſentation. In the plate of ſquares, the ſcale is ſhewn advancing toward C: and if the original ſquare be ſuppoſed to be in width any number of feet, 10, 20, &c. this ſcale ſhews the progreſſive diminution of that dimenſion. The reader will alſo obſerve how readily a figure *reverſe* from the firſt is procured, &c. The ſame proceſs may be uſed on the vertical plane, for vertical objects.

PLATE XVIII.

No. I. Is the proceſs of putting into perſpective a PENTAGON, and is in its operation preciſely the ſame as former figures. A D E B F is an original figure; unite the various ſides to the ground line (as A D at 1: E B at 2; and A F, B F, as near F): parallel to D A 1 draw from I, I K; parallel to E B 2 draw from I, I J; draw likewiſe from I, parallels to A F and to B F. The various ſeats of the original lines on the ground line, drawn to their reſpective vaniſhing points, form the figure. *E. gr.* 1 to K gives *a d*; 2 to J gives *b e:* and ſo of the others: a line from *d* to *e* parallel to H L completes the proceſs.

In treating a ſquare, No. I. Plate XVI. we obſerved, that if an angle of 45 degrees had been made at I, it would have given the ſame points for vaniſhing points as the formation of an original angular line does. In the ſame manner, the points for a regular pentagon, and for any polygonal figure, may be found according to the following TABLE.

Sides.	*Angles at the Center.*	*Angle made by the Sides.*
4. A ſquare makes an angle of	90°	90°
5. A pentagon	72	108
6. An hexagon	60	120
7. An heptagon	$51\frac{3}{7}$	$128\frac{4}{7}$
8. An octagon	45	135
9. A nonecagon	40	140
10. A decagon	36	144
11. An undecagon	$32\frac{8}{11}$	$147\frac{8}{11}$
12. A duodecagon	30	150

The angle at the center of a regular polygon is found by dividing 360 by the number of ſides: thus 360 divided by 5, gives 72 degrees for the angle at the center of a pentagon: 360 divided by 6, gives 60 degrees for the angle at the center of an hexagon. But the angle made by the two adjacent ſides of a polygon is found by ſubtracting the angle at the center, from 180 degrees; thus from 180 take 72, there remain 108 degrees, which is the angle made by the ſides of a pentagon: if from 180 we take 60, there remain 120 degrees, for the angle made by the ſides of an hexagon, and ſo of others.

PLATE

PLATE XIX.

No. I. This example ſhews the readieſt method of putting a circle into perſpective: firſt, form the ſquare A, D, E, B, round the circle, which it touches in four points; each angle of the ſquare is biſected, by ruling through the centre of the circle diagonals to the oppoſite corners; where theſe ſtrike the circumference of the circle, rule lines parallel to AD, and to BE; thus we have four additional points: unite the original lines to the ground line, and likewiſe one for the diagonals, as at A: theſe, prolonged to the vaniſhing points, will give for the ſeat of the circumference of the circle, *firſt*, the ſides of the ſquare; *ſecondly*, four additional points (1, 2, 3, 4, correſponding to the ſame numbers in the figure) indicated by the interſections of the tranſverſe lines: theſe eight points, united carefully, will deſcribe a circle. It is obvious to remark, that the ſame eight points would repreſent an octagon, if united by right lines, inſtead of circular.

No. II. Is a circle put into perſpective by means of its given diameter 1 2: the ſyſtematic lines as uſual. Set one foot of the compaſſes in H, and with the opening HI, ſtrike IB: then with the opening LI, ſtrike IA: through the middle of 1 2, draw a line from C, likewiſe another from H, and another from L: then the points which form the circumference are thus found; 1 and 2 are already given; as being the original line; 3 is found by drawing L 2, which cuts the line 3 C in 3; 4 is found by drawing L 1, which cuts the line 3 C in 4; 5 is found by drawing B 2, which cuts the line 5 H in 5; 6 is found by drawing B 1, which cuts the line 5 H in 6; 7 is found by drawing A 1, which cuts the line 7 L in 7; 8 is found by drawing A 2, which cuts the line 7 L in 8; the points thus procured, muſt be carefully united: this method ſerves for an octagon alſo; and is the readieſt way to repreſent circles within others.

PLATE

PLATE XX.

No. I. Shews the effect of circles forming a cylinder, ſtanding erect, and is an advance toward putting ſolid bodies into perſpective. C is the center; C Y the horizontal line. The diſtance is ſomewhat more than double C Y, and may be conceived as placed at the other extremity of that line, but is omitted in the plate, and its half diſtance marked *.

We may obſerve, that, as a cylinder is apparently to the eye, two circles united by right lines, ſo to put this figure into perſpective, form firſt the inferior circle (by No. 2, if you pleaſe); then erect perpendiculars, and form the ſuperior circle by the ſame method. This example may likewiſe be performed, from having only a ſingle line given as a diameter, as 1 2; which has been already illuſtrated.

No. II. Repreſents the effect of circles when parallel to the picture; as in a cylinder lying along the ground. Circles, parallel to the picture, ſuffer no change in their ſhape, but only in their ſize. On the ground line as at A, and B, place the diſtances between the circles. *Firſt*, Aſcertain the ſeat of the cylinder, which rule to the center C, its proper vaniſhing point; then rule A and B to their vaniſhing point: at the interſection of A, with the ſeat of the object, raiſe a perpendicular; and, taking the propoſed diameter of the circle, ſtrike the circumference from *a:* rule *a* to the center C; and on this line will be ſituated the centers of every other circle, neceſſary to deſcribe the figure: as appears at *b*, &c.

PLATE XXI.

No. I. Shews how to repreſent a ſolid ſquare, or cube: and is performed by finding firſt the perſpective ſeat of its plan; vide No. I. Plate XVI. which gives *a b* for the ſeat of A. B. On the ground line erect the propoſed height of the object, as at D, which unite to C: then at *a* and *b* erect perpendiculars, which will be cut by the line D C, at their proper height, and form the neareſt face of the ſquare, as at *a b* 1 3. The further face of the ſquare is found by the ſame means; and the top of it, by ruling from the interſections with D C, lines parallel to H L, as 2 4, and 1 3, to complete the figure.

No. II. Illuſtrates the principles of the perſpective repreſentation of a pyramid: firſt, find its perſpective plan; vide No. II. Plate XVI. For the height of the object, take *f g* perpendicular to the ground line; find the center of the plan of the pyramid, by drawing the croſs line *a b*; then draw *d* towards C, till it interſects *a b*; raiſe on this center a perpendicular; where it is cut by *g* H is the top of the pyramid; to which rule *a b d* to complete the figure.

PLATE XXII.

No. I. A cube in perſpective, ſtanding oblique to the picture: find its perſpective plan, as before: erect perpendiculars from its extremes; for the height, draw 5 H, which gives by its interſections part of the top; from L draw lines through theſe interſections, which by cutting the remaining perpendiculars complete the figure. Obſerve, that when the ſquare ſtood parallel to the picture, as in No. I. Plate XXI. the height was ruled to C, the center; but when it ſtands oblique, the height is ruled to the vaniſhing points of the ſides.

A cube, like a cylinder, is compoſed of ſimilar faces united by right lines, and therefore may be conſidered as being two perſpective plans of the ſame figure, at different heights, connected together; and the ſame idea may be attached to various polygonal figures.

No. II. Is a double croſs in perſpective: ABCD is the ground line, on which the thickneſs of the upright is to be marked, as BC; and the extent of the croſs bar, as AD: theſe meaſures are ruled to L (the center in this example), and by the diagonal D ruled to H, form a ſquare, which is the plan of the figure. On C erect a perpendicular to receive the meaſures for the heights, as G F, and E; from the interſections of the plan, raiſe perpendiculars for the upright, as from *b c f*; where theſe are cut by the meaſures G L, F L, and E L, rule horizontal lines for the ſituations of the bars, whoſe lengths are determined by perpendiculars from the plan below: thus 1 2 are governed by *a h*; and 3 4, by *d e*: the figure diſtinctly deſcribes the whole.

No. III. Another croſs which ſtands oblique to the picture: it follows the ſame rules as the former, except as to the obliquity of its vaniſhing points, as appears by the figure.

PLATE XXIII.

Though circles parallel to the picture be extremely eaſy, yet the moſt troubleſome ſubjects in perſpective are repreſentations of circular members, and objects, in compoſitions of architecture, when ſeen obliquely. Their ſquares and cubes follow the principles recently illuſtrated, but by way of explaining the difficulty of their circular parts, we ſhall offer the following method of delineating them.

THE TUSCAN BASE IN PERSPECTIVE.

The difficulty in this inſtance is, to repreſent the ſwell of the torus: to accompliſh which, make a ſketch of the parts intended to be repreſented, as near as convenient to the place they are to occupy, as at X, divide this into as many parts as are requiſite, as horizontally at 2, and vertically at *x*.

Take *a x* for the height of the plinth: divide the torus itſelf in half, as at 2, for its height, and *x* for its width: rule *x* perpendicular, and 2 horizontal: then where the line *x* touches the outline of the torus, rule lines parallel to 2, as 1, 3; rule alſo 4, 5, parallel to 2.

Put the plinth into perſpective as uſual. Having procured the perſpective center of the baſe, *o*, by ruling the diagonals of the plinth, raiſe a perpendicular, as *o* K; through *o*, draw a line for one diameter, parallel to D B, and from the half of D B as A, draw through *o*, to the vaniſhing point S, for the other diameter. Procure the plan of the circles as already explained At A erect a line, which is to receive the diviſions made on the original ſketch, 1, 2, 3, 4, 5; this now repreſents their heights: to repreſent their projections, ſet off their meaſures from the point A, as to J, from the points A 1, 2, 3, 4, 5, draw lines to the vaniſhing point, cutting the line *o* K, in 1, 2, 3, 4, 5. Thus we have the line A 5 for the heights of the figure next to the eye, and the line *o* K for their heights at the ſemi-diameter of the column. Now rule the meaſures of the projections, which are marked between A and J to their vaniſhing point, and where they ſtrike the plans of the circles already formed, erect perpendiculars, as at *a*, *b*, *c*, the points where theſe perpendiculars are cut by the lines A 1, 2, 3, 4, 5, in their progreſs to *o* K 1, 2, 3, 4, 5, are ſo many points on the outline of the torus, and other parts of the original ſketch, which if carefully united, will deſcribe its whole form.

Having found the perſpective repreſentation of the figure in its part neareſt to the eye, rule from the line *o* K, horizontal lines which denote heights, 1, 2, 3, 4, 5; and as before, on the points where the plans of the circles are cut by the widths of the members, erect perpendiculars, forming ſo many ſections of the figure, in ſuch parts of the circumference as as may be thought neceſſary.

PLATE

PLATE XXIV.

A TUSCAN CAPITAL IN PERSPECTIVE.

In order to vary the application of the foregoing principles, this object is ſeen *underneath*. Its dimenſions are obtained by forming a ſketch of its parts adjacent to the ſpace it is intended to occupy, as A, 1, 2, 3, 4, 5, 6, 7. Then fix the extent of its broadeſt part neareſt to the eye, the abacus, as C D: in the middle of this, let fall a perpendicular, as J *r*, which is to receive the heights marked A 1 to 7, and from J towards D, ſet off the widths, *a*, *b*, *c*, *d*, *e*, *f*, *g*, as marked on the original ſketch. Rule the heights to L the center, and the widths to H the vaniſhing point, their interſections give points which muſt be carefully united, to form the outline.

As there is ſome patience required in treating ſuch objects, the beſt way is to procure the extremes within which the parts to be repreſented muſt fall: as in the former plate between A 5, and *c*, *d*, ſo in this plate between the line J *r*, and the interſection which finds the upright line *g*; then take the larger members firſt, and having placed them, with their proper intervals, the leſſer members which fall within thoſe intervals will follow more readily. In fact, when the ſtudent becomes acquainted with the forms of objects, and conſiders their appearances in nature, which after having thus inveſtigated them he will ſurvey with greatly increaſed accuracy of eye, he may by means of the leading circles only delineate with ſufficient exactneſs the forms attached to them. It is well to know how to uſe ſuch principles, when occaſion requires; but to employ them on all occaſions is not neceſſary to a practiſed eye.

Theſe examples ſhould be turned, and drawn on the vertical plane, &c. The principles are the ſame.

PLATE

PLATE XXV.

Shews the inſide of an apartment: C the center; H L the horizontal line; the windows are placed according to meaſures given, and ſet off on the ground line A. 1 2 3 4 refer to the diſtances of the window panes, &c. and being ruled to H, cut the line A C, at the proper places, from whence perpendiculars being raiſed, the wall of the window is found. The panes being ſuppoſed at the outer edge of the wall, require the continuation of the lines 2 H, 3 H, croſs the window ſill 5, 5, in the neareſt wall, parallel to H L. The upright meaſures, 5, 6, 7, 8, 9, determine their heights, not only in the neareſt wall, but (by being ruled to C) in the furtheſt wall, by their interſection with it; to which 5, 6, 7, 8, 9, are parallel. The lines are continued croſs the window ſill for the panes, in the further wall, to C, as before, along the floor; and their diſtances from each other are regulated by the original meaſures on the ground line, drawn to C, as appears at 1, 2, 3, 4, under the window. All meaſures for horizontal objects muſt be placed on the ground line, or on a line parallel to it, in ſome convenient part of the picture; and all meaſures for vertical objects, on an upright line.

No. II. Is a repreſentation of a bureau, with the flap open; which is much the ſame as the trap door, in the next Plate: *e* is its hinge, *f* its edge, *a b c* the circle it forms in opening, O O on the line O X, two points which aſſiſt in drawing the circle; X the diſtance of that circle: A is one ſide of the bureau perpendicular to the picture, and B the ground line.

PLATE

PLATE XXVI.

Suppoſing theſe examples ſufficient to explain the manner of treating ſolid bodies, &c. we proceed now to ſhew the nature of other objects. It has already been obſerved in LECTURE II. that all rotatory objects form a circle at their circumference, of which the hinge is the center: on this principle are the doors in this example put into perſpective.

Fig. 1. C is the center, H L the horizontal line; the breadth of the door is marked on the ground line, as A B; and A D is the depth it muſt be in the room. Draw D H, cutting A C in E; draw from E, a line parallel to the ground line, as E F; which is cut by B C in F, and determines the width of the door at that part (if half open); F ruled to H will give *e* for the edge of the door, if ſuppoſed ſhut: the ſemicircle on the floor is formed by the ordinary methods. From the bottom of the door E, to the circumference of the circle, gives the ſituation of the door: the ſame line continued to H L gives its vaniſhing point, as at I: perpendiculars from the bottom of the door, and its edge, are cut by a line from I, to determine its height. In Fig. 2. the door is ſeen open ſomewhat differently: the ſame proceſs gives K for its vaniſhing point; as is clear by the figure.

Fig. 3. Is a repreſentation of a trap-door in the floor: A B its breadth; which of courſe is the front of the aperture. The door C, and its hinge D, are found exactly as the ſame parts in the foregoing figures; *g* is one vaniſhing point for the quarter of a circle, correſponding to the ſquare A, D, *e*, *f*.

If this figure, and thoſe of the former numbers are turned, and viewed ſideways, they mutually illuſtrate each other.

PLATE

PLATE XXVII.

No. I. As all horizontal and vertical planes, and objects, in every ſituation, however diverſified, follow the rules already laid down; we preſume what has been ſaid may ſuffice to explain the method of repreſenting them in perſpective: we proceed now to illuſtrate the nature of planes not perpendicular, or parallel, to the picture, but *inclined* to it.

In this example, C is the center of the picture, C I its diſtance, H L the vaniſhing line of the ground plane R Q. The line R * marks the inclination of the plane to be repreſented, with the picture (and is here ſuppoſed 70 degrees.) Through C, draw C G, parallel to the line R *, and of equal length to the diſtance C I; perpendicular to C G, erect C S: through S, draw A S B parallel to C G; this is the vaniſhing line for the plane propoſed, S its center, and S G equal to its diſtance.

This object has faces in three different inclinations; firſt, that lying on the ground, which accordingly vaniſhes in the vaniſhing points to the ground, as *d f* and *e k*; ſecondly, other faces perpendicular to the ground, as *e k l g*; thirdly, an inclined face not parallel to either, as *d f l g*; which is our immediate object. E D F is an original plan, whoſe lines being continued ſtrike the ground line in R, and Q, &c. Rule R to L, being coincident with the ground plane; and Q and its parallel to H; by which we obtain *d f* for the repreſentation of D F: and by the ſame means, we obtain *e k*, which now completes the perſpective plan of the object. From *d* draw *d* B; from *f* draw *f* B: erect on *e* a perpendicular, which cuts *d* B in *l*: and from *l* rule *l* L, cutting *f* B in *g*; which completes the figure.

M K Shews the ſide-elevation of this object.

PLATE

PLATE XXVIII.

Figure 1. Repreſents an inclined plane, one ſide of which is parallel to the picture: erect on the center a perpendicular at pleaſure; and at H, form ſuch an angle as the plane to be treated is ſuppoſed to make; as at K. Rule a line in that direction from H, till it interſects the perpendicular from C, as at I: through I, rule a line parallel to H L, as V I; which being the vaniſhing line to the plane, governs its perſpective. To I (its center), rule D and E; to C, the center of that part coincident with the ground, rule D C; on *a* erect a line, which cuts D I in A; from A, a line parallel to H L completes the figure: or A may be found by its proper diagonal (being a ſquare) ruled to V, its vaniſhing point, as appears by the figure.

Figure 2 is a ſimilar example, and the ſquare *e d f g* is found as ſquares in general: V I being its vaniſhing line.

PLATE XXIX.

No. I. Is an application of the foregoing principles to a natural object, and repreſents a flight of ſtairs in perſpective: C is the center of the horizontal line; O is the angle made by the aſcent of the ſtairs; and gives V for the tranſpoſed center, to which the inclined lines are ruled. The meaſures of the ſtairs are ſet on the ground line, as at 1 2, and 3 4. The ſhadow of the rail D is found by taking A B as a ray, to which all ſhadows that fall on the uprights of the ſtairs are parallel; thoſe which fall on the horizontal parts of the ſtairs follow their direction and vaniſh in C.

PLATE XXX.

INCLINED PLANES ON INCLINED PLANES.

Figure 1, Repreſents a priſm (one of whoſe ſides is perpendicular to the ground) reſting on an inclined plane: this figure is an advance on Plate XXVIII. C is the center of H L, the horizontal line; Z is the original plane, and Y the priſm ſtanding on it. Draw through C, a line perpendicular to it, as V C O: place the priſm Y at the point of diſtance H, and rule lines equal to the angles it makes, to O and to V; through theſe points, O and V, draw lines parallel to H L, which thus become vaniſhing lines to its upper and under faces. The upper faces of Z and Y being parallel, have the ſame vaniſhing point (O). The plane B, Figure 1, follows exactly No. 2. Plate XXVIII. take *g h* for the ſeat of A on B; from V draw V *g*, V *h*, beyond *g* and *h*; and by the diagonal N *g* prolonged beyond *g*, cutting V *h* in *b*, we obtain one termination of this face, which is completed by ruling *a b* parallel to *g h*. Now rule for the other face *a* O, *b* O, which, cut by the diagonal *b* K, will give *c d* for the termination of the other face; or, it may be found, by erecting a perpendicular from *g* to *c*, and drawing *c d*. *e f* on the ground line marks the width of A.

In Figure 2, the plane A is conſtructed in a ſimilar manner with B in Figure 1. *e g* vaniſhes in V; and *f* denotes the middle of the object: *a b c d* is a ſquare lying oblique to A; whoſe ſides *a b*, and *c d* vaniſh in K: and *a c* and *b d* vaniſh in a correſponding point on the other ſide O.

PLATE XXXI.

No. I. Is an application of the principles and management of inclined planes to landſcape: in this example, we have a flat country, interſected by a deſcent (I *b a* G) and a riſing ground (*d n* K *c*). For the flat country, H L is the horizontal line, and C the center. E B F is the vaniſhing line of the deſcending plane, (conſequently below the horizon) B its center, L B its inclination. S A is the vaniſhing line of the aſcending plane, (conſequently above the horizon) A its center, H A its inclination. Firſt diſpoſe of the flat country, by drawing I C, G C, the houſe M (whoſe vaniſhing point is D, &c.) Then for the deſcending plane, draw I B, G B; a diagonal from G to E gives *b* for one termination of this plane, which is completed by a line (*b a*) parallel to I G. The poſts U T, and their ſhadows, all vaniſh in B. For the aſcent, take *d c* as a ground line, and rule *d* A, *c* A, cutting I C in *n*, and G C in K. The water is of neceſſity horizontal, and therefore vaniſhes in C.

To find the point *k* in the water (*a o* being its ſurface), draw the perpendicular K *k*, and *a* C, cutting it in *r*, which is the ſeat of K on the water; make *r k* equal to *r* K, for the reflection of K in the water: *q* is the reflection of *p*.

The ſhadows are caſt by the ſun ſuppoſed to be parallel to the picture, in the inclination R; parallel to which, draw *l i*, and parallel to H L draw *b i*; unite I *l i* for the ſhadow of I *l*: to continue the ſhadow on the water, draw *i* C, which is cut by the bank at *m*; unite *m n*, which completes the ſhadow of I *l n*.

No. II. Is another application of theſe principles to landſcape: C the center, H L the horizontal line, D G the ground line, D A the height of the riſing ground, if it was ſituated on the ground line; N B its height at N; K I, if produced to H L, is the diſtance. The houſe E vaniſhes in C. The reſt is explained in the former figure, or is too obvious to need explanation.

As

As the whole proceſs of practical perſpective is intimately connected with the foregoing liſt of plates, it is proper to requeſt the particular attention of the ſtudent to them; eſpecially, as he is aſſured, that they contain nothing ſuperfluous, or that may be diſpenſed with, but are inſerted with deſign, that he may eaſily carry in his memory the rules they exemplify. It is neceſſary to be explicit on this ſubject, becauſe it is very uncommon to treat this ſcience ſo conciſely in regard to the number of plates; but there is much reaſon to imagine that multiplied examples, and too numerous plates, have frequently prevented that attention from being beſtowed on it, (becauſe ſeemingly attended with difficulty) which the ſcience deſerves: whereas, in fact, its principal rules are by no means either difficult or complex; and the trouble connected with any part of it ariſes rather from the nature of certain objects to which it is applied, and from the inventions of ornamental decorations, whoſe compoſition is intricate. Now as the members of any part of a building are but diviſions or portions of a certain extent, it is clear, that, if we are able to repreſent that extent, and to divide it into ſuch portions, we are alſo able to treat whatever thoſe portions may contain: and thus the uſe of perſpective appears moſt evidently in thoſe articles, whoſe juſt repreſentation is naturally difficult, and without this aſſiſtance impoſſible.

It will be extremely eaſy for the ſtudent to multiply examples ſimilar to thoſe here offered him; and indeed it is adviſeable that he ſhould vary and diverſify

verſify them at his pleaſure; whether by giving various directions to his original lines, or by drawing on the right hand, what is here given to the left, or by any other change which fancy may ſuggeſt.

It is alſo proper to remark, that the conſtruction of horizontal pictures is preciſely the ſame as that of vertical pictures, which is eaſily experimented by looking up to the ceiling; in which caſe, the center beam or ray from the eye equally regulates every other line: the ſame if a perſon from a high parapet looks down to the ground; the wall of the houſe which ſupports the parapet, anſwers to the ſituation of a horizontal plane, and the ground is to him vertical. But as it is hardly to be ſuppoſed that our readers ſhould undertake ſuch ſubjects, the preſent hint is thought ſufficient without examples.

Perſpective has by ſome perſons been applied to repreſent as receding what really approaches, and to bring forward what retires; but at the ſame time that this is allowed to be curious, it is equally conſidered as uſeleſs, and merely is the effect of irregular ſurfaces forming one picture.

It is amazing to ſee the errors committed by artiſts (not otherwiſe without merit) in their repreſentations of ſundry objects, and even frequently of ſpaces and diſtances: whereas, if they would inſert on their deſigns merely three or four of the principal directing lines, they could not poſſibly commit ſuch miſtakes. Even in compoſitions of figures, it is adviſeable to make uſe of a height correſpondent to that of a figure, and to graduate the ſame towards the

horizontal line, as a directory for figures, &c. removed from the front of the picture. The ſame ſcale would ſerve to proportion other objects, ſuch as houſes, &c. ſince it would then be ſcarcely poſſible to repreſent dwellings ſo ſmall as to be uninhabitable, or their doors ſo ſtreight as to deny a paſſage; as on the other hand, it would prevent their dimenſions from ſuiting giants rather than men.

With regard to planes inclined to the picture, and to the horizon, it may be obſerved, that it is not always neceſſary to delineate them by the proceſs here given; but if the ſituation of the extremes of that portion of the plane which is wanted, can be determined by means of any points already obtained, they may be repreſented very eaſily: as for inſtance, the roof of a houſe, if the part where it joins to the front wall be ſuppoſed, or given, and the ſame at the ridge of the roof, it is evident, that theſe points united by a line, give the direction of the roof; and as the ridge is uſually parallel to the front wall, it equally directs the roof in every part. The ſame remark applies to landſcape: it is not always neceſſary to draw the inclination of a hill, &c. *geometrically:* by a little practice, the eye will quickly diſcover the true bearings of ſurfaces to each other, and will accordingly treat them with ſufficient accuracy, after having been taught by correct principles.

LECTURE

LECTURE III.

IF the principles, which in the preceding LECTURES have been honoured with your attention, LADIES and GENTLEMEN, have been ſo clearly ſtated as their importance deſerves, I may juſtly flatter myſelf, that the remainder of our ſubject will be eaſily diſcuſſed, and fully underſtood; for, when we have once acquired accurate ideas of objects as ſeen in perſpective, and know how to repreſent them juſtly, and on genuine principles, we ſhall need very little exertion of genius, or of ſtudy, to comprehend aright, the natural effects of their SHADOWS, which, at this opportunity, are the ſubjects to be inveſtigated.

Shadows, are privations, or abſences, of light; cauſed by the interpoſition of bodies ſufficiently denſe to prevent the paſſage of luminous rays; and, though it cannot, with exact propriety, be aſſerted, that ſhadows are the offspring of light, yet it muſt be granted, that, without light, there could be no ſhadow.

Darkneſs was anterior to light, and ſeems more intimately connected with this lower world; ſince ſo ſoon as the great diſpenſer, and cauſe, of light, withdraws his beams, obſcurity returns, and continues, till the activity of the ſolar rays again diſpels the gloom.

But,

But, though "light is pleaſant, and it be a cheerful thing to behold the ſun," yet is too much of this invaluable bleſſing not only uſeleſs, but injurious: ſo that, beſide the wonderful proviſion made in our viſual organs for excluding redundance, our ſenſe of ſight is alſo not a little refreſhed by reviving ſhade; eſpecially if for a length of time it has been expoſed to the action of intenſe light.

If ſhadow be merely an interruption of luminous rays, we may, without reluctance, beſtow a few minutes attention on ſome of the properties of light, ſince perhaps by enquiring into theſe, we may more eaſily comprehend their contraries. The rapidity of light is ſo vehement, that it is juſtly conſidered as to us inſtantaneous, ſo that directly as a body is expoſed to it, or removed from it, the effect is viſible: but, thoſe laws whereby the courſe of light, or of luminous rays, is determined, more nearly concern the ſubject of our attention. For, if, inſtead of conſtantly keeping a direct line, its courſe was oblique, or ſpiral, or volutory in any manner, we ſhould be to ſeek for different principles whereby to aſcertain, and to explain, its progreſs: but, as by the Almighty *fiat*, which ſaid "LIGHT be, and light was," it takes invariably the neareſt courſe from point to point, we acquire, by a ſimple experiment, a perfect knowledge of the principles which determine its direction.

Whoever will interpoſe an opaque body between the origin, and ſource, of light, natural, or artificial, and any proper ſubſtance expoſed to its rays, will eaſily perceive their illuminations are pre-

cluded from the object furtheſt off, by their ſtriking againſt that which is neareſt; and alſo, that a direct line, from any part of the ſpace wherefrom light is ſuſpended, to the luminary, will paſs through a correſponding part of that object which ſuſpends the light. For inſtance, when I hold my hand between the candle and the wainſcot; it prevents the rays of light from paſſing further, and, conſequently occaſions a blank of light on the wainſcot; which blank is directly ſtrait from the candle. And, ſo very minute and correſpondent are the rays of light, to the form of whatever impedes their progreſs, that they aſſume exactly its figure and outline, and deſcribe a figure perfectly ſimilar, on the neareſt ſuperficies which may receive it.

Conſidered as related to Perſpective, light divides into two kinds: each of which claims a proper attention: FIRST, the NATURAL light; the ſolar, or lunar light, whoſe origin being immenſely diſtant from us, and beyond all proportion, with reſpect to objects illuminated by it, is uſually (and with propriety) conſidered as *infinite:* its rays, therefore, are not divergent, but *parallel,* and alike; and this, not only during the radiance of noon, but equally parallel are the beams of "grateful evening mild."

Taking their ideas from circumſtances of artificial light which are familiar to them, ſome have thought that, the ſun may enlighten us from *below*, as does a candle when placed on the ground, though our diſtance from it be conſiderable: and, certain artiſts, not ſufficiently attentive, have enlightened their figures under the eye-brows, chin, &c. in evening pieces:

pieces: but, that it ought not to be ſo, is demonſtrable; for, ſince the horizon, which is the height of the eye (how high ſoever that eye be ſituated), is likewiſe the boundary of the ſolar rays; it is evident that boundary can be only *parallel* to the eye. And it may further be obſerved, that, were the horizon ſufficiently defined, all the figure below the eye would be in demi-tint: this effect we ſee occaſionally in high mountains; on various elevations of clouds; and to this much of the variety of their tints muſt be referred.

It ſcarcely needs remark, that the altitude of the ſun in the heavens, according to the time of the day, and according likewiſe to the ſeaſon of the year, produces variations of ſhadow: for in the morning, as in the evening, the ſhadow occaſioned by the ſun's place is infinite; whereas, at noon, the ſhadow deſcribes a certain angle with every perpendicular object. In the ſame manner Spring and Summer differ: for the ſun's place in the ecliptic is perpetually changing. What is in this reſpect true of the ſun, applies with equal propriety to the moon; which ſometimes riſes near the horizon, and ſpeedily diſappears below it, ſometimes purſues a track, whoſe arch ſeems near the zenith.

Nor ought I here to omit obſerving, that the various ſituations of countries, make a difference which deſerves notice; for the ſun being the origin of light, and its elevation being unequal, in unequal latitudes, theſe variations muſt needs occaſion a diverſity of ſhadow, as well as of general effect.

GERARD DE LAIRESSE relates an incident, which confirms the propriety of this obſervation: "Being employed by a gentleman, who had been a governor in India, to paint a ſcene in that country, I made (ſays he) a ſketch of it, in his preſence, which ſatisfied him; and having painted the picture, was deſired to ſee it hung up: after the gentleman had viewed it, he whiſpered to me,—'It is very well done; but I forgot to tell you one thing of great moment; you can alter it in half an hour's time.' To be ſhort—I had taken the ſun *too low*, and had alſo made him fall into the piece *ſideways*, which occaſioned long ground ſhades: whereas, he ſhould have been nearly vertical; as in that country he generally appears." The artiſt could not but acknowledge the fault; though it was by no means to be rectified ſo eaſily as his employer ſuppoſed, ſince every light, and every ſhadow, throughout the compoſition was erroneous: and to rectify one, or even many, had been to little purpoſe, without rectifying the whole.

Your recollection, LADIES and GENTLEMEN, will furniſh you with other particulars to which theſe hints may be adapted, ſince they are of very general application. I ſhall mention one circumſtance, which, not having ſtudied from nature, I confeſs my incompetence to determine; and that is, the difference (if any) of ſhadow, or of light, in the two hemiſpheres, and, whether the ſouthern and northern, are alike in this reſpect; whether they offer the ſame ſhadows, of the ſame kinds, and

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of the ſame appearance; or, whether there be any ſenſible, or permanent, difference: and moreover, what is the general appearance and effect of the ſhadows cauſed by a vertical ſun, which I ſuppoſe, is ſometimes rather curious. Time has been, according to HERODOTUS, when thoſe who, having paſſed the line, aſſerted that the ſun was at their backs as they proceeded ſouth, were conſidered as lying travellers; nevertheleſs, that fact is now acknowledged; and is the ſtrongeſt argument for the truth, and the actual performance, of the voyage of which HERODOTUS profeſſed to doubt. The ſame cauſe may perhaps produce other differences allied to our ſubject: but not inclining to undertake a voyage to the line, or to either pole, merely to inveſtigate the ſubject of lights, though I think many amuſing peculiarities muſt occur to the ſurprize perhaps of the inſtructed obſerver, I reſt content with a knowledge of the lights procurable in old England, and proceed to offer a few hints on the effect of ARTIFICIAL LUMINARIES; which is the SECOND kind of light to be conſidered.

The immenſe diſtance of the ſun, or of the moon, renders the rays they emit parallel; but, as artificial lights, a torch, or a candle, have not, cannot have, equal diſtance, the rays they emit are eaſily traced to one point, around which they ſpread. Thus, although it be impoſſible, by changing the diſtance of a figure illuminated by the ſun, to ſhew any variation of lights, and ſhades, in ſuch a figure, yet merely the alteration of diſtance produces very remarkable diverſity in the ſame figure, ſeen by artificial

ficial light; for, hereby the ſhadows are rendered ſhorter, or longer, and the lights become brighter, or weaker. Moreover, the extent of ſhadow projected from an object, by means of artificial light, bears no proportion to the ſize of the object itſelf, but may be made to exceed it by very much; as, when I approach my hand to the wainſcot, in proportion as it advances toward the ſeat of the ſhadow, the ſhadow correſponds to its natural dimenſions; but, when, withdrawing my hand from the ſeat of the ſhadow, I advance it toward the light, it intercepts a much greater body of rays emitted by the luminary, and, conſequently, its ſhadow occupies a ſpace proportionably greater on the wainſcot; and this ſhadow may be increaſed till half the room is deprived of light. You ſee, likewiſe, that by placing it *above* the candle, its ſhadow appears on the ceiling; an effect which we very well know it is impoſſible ſhould attend the rays of the natural luminaries; and you ſee too, that the light *always* preſerves its direct line; ſo that let me move my hand on either ſide of the luminary, and to any ſituation within reach of the rays, the place of the ſhadow correſponds perfectly to the immediate ſtation of the candle.

The infinite variety of ſituations, wherein torches, lamps, &c. may be placed, produces a correſpondent variety of effects; and precludes any determinate remarks on any ſpecific inſtance of effect; ſince, what obſervations might be very juſt, when applied to one inſtance, might be utterly inapplicable, perhaps falſe, to another. Indeed, we have

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no need to wiſh for better principles on this ſubject than we poſſeſs, as our rules are ſo general, and ſo ſimple, that they readily apply to all caſes, in which art is likely to require aſſiſtance.

The firſt principle requiſite toward treating ſhadows in perſpective, is, to find the *ſeat* of the luminary; then the ſituation of the planes around it, on which its light falls, and laſtly, the relation of the objects enlightened to thoſe planes.

I venture to differ from general opinion, and method, in placing firſt the principles of artificial light; becauſe, I conceive, that the expreſſion, and the nature of the *ſeat* of a lamp, or of a candle, conſidered as a luminous body, is more eaſily underſtood, than the *ſeat* of the ſun; and eſpecially, as I wiſh to appeal to nature in all caſes, and as this may, with the utmoſt eaſe, be reduced to the teſt of experiment; which is more than can be ſaid concerning natural luminaries, though by fair inference we juſtify our principles reſpecting them.

This table is an horizontal plane, on which the candleſtick ſtands; you comprehend without difficulty, that, perpendicularly *under* the flame, is the *ſeat* of the light on that plane: this is too clear to need enlargement. With equal evidence it appears, that the *ſeat* of the light on the ceiling, is, immediately perpendicularly *above* the flame; to prove which, we have only to ſuſpend a ſmall ball at the end of a line, and, by placing it over the candle, the ſhadow of the ball on the ceiling demonſtrates the truth of this principle. By ſimilar methods is the

the ſeat of light found on any other plane, it being always that ſpot, which is indicated by a ſtraight line drawn from the center of light, to the moſt direct, and proximate, part of the plane;—as on the ſide of this room, the ſeat of the light is, in that part neareſt to the luminary, and thereby moſt expoſed to its immediate, and vigorous rays.

I perſuade myſelf, this ſyſtem is too evident to require further explanation; and not leſs ſimple, and facile, is its application; for, if we deſire to trace the courſe of a ſhadow which falls on any plane, we have little more to do, than to conſider the direction of the object which caſts it; and by finding the ſituations of the ſhadows of its extremes, or terminations, we have almoſt in a general view, accompliſhed our purpoſe.

If an object be perpendicular to a plane, the courſe of its ſhadow will be, a continued divergence, or receding from theſe at of light on that plane, as from a center; and the length of this ſhadow will be determined, by lines from the luminary through its extremes; interſecting the courſe of the ſhadow. If an object be oblique to a plane, rays drawn from the luminary through each extreme, or termination, give the ſeat of its ſhadow on the plane; if it be parallel to a plane, the ſhadow follows the courſe of its parallel, and vaniſhes in its vaniſhing point. It is true, that as well objects, as planes, *may* be ſo tortured into awkward ſhapes, and forms, as to occaſion much trouble and embarraſſment to find the images of their ſhadows;

yet, if we can aſcertain their repreſentations on any one plane, the others become manageable.

Artificial lights ſeem more directly under our controul, and regulation; I have, therefore, introduced them before the obſervations I intend to offer on the principles of ſhadows occaſioned by the ſun, or the moon; but the rules to be adopted, in treating theſe, are founded on a ſimilar mode of reaſoning, though on a ſcale differing in extent.

It is, indeed, impoſſible to *fix* a natural, and real, ſeat for the ſun, on any part of our ſmall ſurvey of this our globe, becauſe, very diſtant from us, is that ſpot where he is vertical; yet, as we know his light has an apparent ſeat on our horizon, (conſidered as a plane) and that ſhadows of objects always bear a certain reference to the ſeat of light, as lately explained, and always recede in ſtraight lines from it; by finding a point correſpondent to the apparent ſituation of the luminary, and another, the neareſt that can be drawn from that ſituation to our horizon, for the ſeat of its light (which is evidently an application of the procedure juſt ſuggeſted) we poſſeſs principles which apply to this occaſion alſo.

The center of the picture, the horizontal and vertical lines, have already engaged our attention, and we ſhall receive from them much aſſiſtance on the preſent occaſion. Let us imagine the vertical plane to be erect before us; and then—the ſun to be on one ſide of it,—to the *left* firſt, in the preſent inſtance. It is evident, that, according to his *obliquity* from that plane, his rays will be more or leſs

declined, with reſpect to ourſelves, and to our ſituation. If we keep our ſtation, while the ſun, by degrees, approaches toward the direction of that plane, the declination of his rays gradually leſſens, till at length they become union with it, and we receive them full in the face. When the ſun in his progreſs is advanced to the *right* of the plane ſuppoſed, the declination of his rays is proportionably augmented, till at length they ſhoot directly *acroſs* the center beam of the eye: that eye looking the ſame way as at firſt.

During his progreſs hitherto, we have been able to aſcertain, on the picture, a point correſpondent to the ſituation of the luminary, which may be denominated his *place* on the picture; and, which is, where a line drawn from the eye to that elevation at which he appears would cut the picture. This *place* on the picture muſt, of neceſſity, be *above* the horizontal line, as we may be ſaid, in effect, to ſee the luminary, only very obliquely; but ſo ſoon as he paſſes behind us, his place on the picture falls *below* the horizontal line, and the greater his elevation, the lower is that place; till as he ſets behind the horizon, it becomes union with the horizontal line. In this courſe (if we incline to the ſuppoſition of a lengthened day) he may twice be in union with the vertical plane; once, right before the ſpectator; afterwards, right behind him. And if the ſun was, during the whole *nucthemeron*, (or day of twenty-four hours) above the horizon, as he is in the polar regions, in ſummer, he might alſo be twice in the

the plane of the picture, and twice in every angular horizontal obliquity.

A propos—methinks it muſt ſomewhat embarraſs natives of theſe medium latitudes to diſtinguiſh day from night, ſhould they viſit the polar regions, during their ſummer, when, as we have ſaid, the ſun is conſtantly above their horizon. The idea is curious, of a night-piece by *ſun-light:* or, can it juſtly be denominated *night* while the ſun ſhines? If it may, it palliates the ignorance of that painter, who unable to repreſent a moon-light, illuminated by ſun-ſhine, even his midnight ſubjects.

But there is no need, that we, perſonally, ſhould ſpend a whole day in watching the courſe of the ſun; ſince all fixed objects may be ſaid to do it for us. The windows of our houſes, for inſtance, may confirm theſe remarks; ſuppoſe they have a ſouth aſpect, then, in the morning, the ſun ſhines *along* the front of the houſe, but not into the windows; at noon, he ſhines direct into the rooms, through the windows, and the ſhadows of the window frames, which, until noon, had fallen to the right, gradually fall to the left: till at length they become one with the wall of the houſe, as the ſun advances to his evening ſtation.

Or, further to illuſtrate the principle, let us advert to a horizontal ſun-dial in an open place; and this the rather, becauſe, the lines which mark the hours, form at once a regiſter of the progreſs of the light, and ſhadow, and of thoſe effects which they have produced during the day, *i. e.* they deter-

mine, and note the obliquity of the ſun. Let us ſuppoſe the gnomon of ſuch a ſun-dial to be a large tranſparent picture. The gnomon is always et north and ſouth. Now, at noon, when the ſun is ſouth, he is in the plane of the gnomon, or picture, conſequently, he has no obliquity, or angular declination, but, his elevation in the heavens is the only thing neceſſary to be conſidered; whereas, at one o'clock, two o'clock, three o'clock, &c. it appears, by the hour lines, that his obliquity is conſiderable, and increaſing; let him keep on his courſe till ſix o'clock; and here, let him wait a few minutes, till we have made our remarks.

If we go behind this large tranſparent picture, we ſhall ſee the body of the ſun *through* the picture; to determine his place, we have only to mark the ſpot he appears to occupy; and, to find the *ſeat* of this luminary, we muſt let fall a line from this ſpot to the horizon; that part of the horizon where this line falls, will be the point toward which all ſhadows on the horizontal plane, though falling from their objects *towards* us, yet will ſeem to tend: this then is their vaniſhing point:—the vaniſhing point, on the horizon, of all ſhadows falling on the horizontal plane.

Let us exemplify this, in relation to the perſon whom we have ſuppoſed to be the ſpectator: as the rays of the ſun paſs through our tranſparent picture, they naturally fall on the perſon who is behind it, and he, by intercepting them, caſts a ſhadow on the ground behind him; now, if from the place where the

the ſhadow of his head falls (he ſtanding upright) a line be drawn through the ſeat of his feet, this line will ſtrike the horizon, preciſely in the point where the ſeat of the ſun, *i. e.* of the ſun's light, is on the horizon before him; and ſuch a perſon will ſee the whole of the ſhadows falling from objects, and the whole of the darkened portion of thoſe objects.

Reverſe now the ſuppoſition; the ſpectator remains no longer behind the large tranſparent picture, but, he comes before it, and turning his back to the ſun, he inſpects *that* picture in front which lately he looked through from behind. It is true, he will ſee another horizon, and another ſet of objects; but though he has changed his ſcene, he has not changed the principles which regulate the ſhadows of all objects which compoſe it. For we are to recollect that the ſhadow from his head, which formerly fell *behind* him, now falls *before* him: and this effect being the reverſe of what was the caſe formerly, let us ſo far reverſe our procedure, as to draw our line from the ſeat of his feet through the ſhadow of his head; and we ſhall find, that by *carrying up* this line to the horizon, we obtain a point, toward which all the ſhadows falling on the horizontal plane ſeem to tend. Theſe ſhadows no longer fall *toward* the ſpectator, but *from* him; he no longer ſees the whole of the ſhadow, but he ſees the wholly enlightened portion of the objects.

That attention to the natural effect of light which I have mentioned, requires both more time and more patience than is abſolutely neceſſary to acquire a ſufficient

a ſufficient inſight into the nature of the angular declination of the ſolar rays; ſince a ſpectator, by *turning himſelf* round, may produce all thoſe declinations in a minute. If the ſun be at firſt behind him, he may gradually turn himſelf, till the ſun ſhine full in his face; and may continue turning, till the ſun be again behind him. In this revolution, he will obſerve every obliquity of light and ſhadow accompanying the moving plane of his own circulating picture; and he will perceive the ſtability of the principles, though his ſituation be conſtantly varying. Thus it appears, that theſe principles alſo, may be brought to the teſt of experiment, whenever the ſun ſhines, and therefore, to that teſt we ſhall refer them. But, though we may thus eaſily experiment the different angular obliquities of the ſun to the picture, yet, for the different elevations of the ſun in the heavens, which form a neceſſary part of our principles and attention,—for theſe we muſt wait the courſe of the ſun's diurnal progreſs.

We have now illuſtrated three chief ſituations; that of the luminary, that of the ſpectator, and that of the picture; *firſt*, when the ſun is in the plane of the picture; *ſecondly*, when he is direct before the ſpectator; *thirdly*, when he is direct behind the ſpectator: after this, very little trouble can attend the repreſentation of any degree of obliquity at which the ſun may happen to be; for, if we place him at the obliquity of one o'clock, two o'clock, or three o'clock, (adverting to the ſun-dial) we readily diſcover by the courſe of the hour lines, at what point

we are to look for him in one caſe: or in the other, we can eaſily draw a line from the ſhadow of our head, through the ſeat of our feet, and where that line cuts the large tranſparent picture, there erecting a line to ſtrike the horizon, we can procure the ſeat of the ſun with certainty.

Having thus pretty fully, and I hope clearly, treated of ſhadows caſt on the horizontal plane: I ſhall only obſerve as to ſhadows caſt on the vertical plane, that they follow the ſame rules, and are of the ſame conſtruction. I think it not neceſſary, here, to occupy our attention with them, as well, becauſe they reſemble thoſe of the horizontal plane, as becauſe, by far the greater number of ſhadows are caſt by objects ſituated on the horizontal plane; as trees, houſes, men, animals, &c. for the ſame reaſons, ſhadows caſt on inclined planes are diſmiſſed with merely being mentioned.

It muſt be owned, great truth is produced in a picture by juſt repreſentations of ſhadows; and indeed, without this, the lights, which always are the moſt attractive part of a compoſition, loſe half of their power; yet, too great an attention to the accuracy of ſhadows, is apt to produce a hardneſs, by precluding that blending, that gentle, and delicate regulation of ſhades, which, if it in ſome ſmall degree ſacrifice truth to grace, yet amply compenſates that ſacrifice, by eſtabliſhing a general harmony throughout the performance.

The method of practice is eaſily deducible from the principles we have ſtated. It is neceſſary to have

have in a perſpective repreſentation of ſhadows, four chief points: *Firſt*, the center, which is the ſoul of the ſyſtem; *ſecondly*, the place of the ſun according to his elevation, and to his obliquity; *thirdly*, a point on the horizontal line, perpendicularly correſpondent to, (*i. e. under* or *over*) the place of the ſun, (which is a kind of tranſpoſition of that place to the horizontal line, ſerving for ſhadows on the horizontal plane); *fourthly*, a point on the vertical line, perpendicularly *lateral* to the place of the ſun; which alſo is a kind of tranſpoſition of the ſun's place to the vertical line, ſerving for ſhadows on the vertical plane.

In diſcourſing on artificial light, we obſerved, that, it was in our power to aſcertain the *real* ſeat of the light, and to place objects beyond that ſeat, from us; conſequently, to enlighten them differently, merely by moving them ſtraight forwards or backwards: but, this we cannot do in the preſent inſtance; on the contrary, all we can accompliſh is, to approximate as near to that ſeat as our horizon will permit, and thereby to tend *toward* the ſun's apparent ſeat. If we inquire after his real ſeat, it is, perhaps, in the morning in the South Sea; at noon, in Africa; in the evening in South America; *i. e.* on that line wherever it be, where he is meridional; therefore evidently beyond our immediate application. But we remark, that the ſun's rays being at an infinite diſtance, are parallel, and therefore as to ſenſe, his apparent ſeat anſwers every purpoſe of his real ſeat. And thus it appears, that although,

although, by his magnitude, and his immenſe diſtance, the ſun obliges us to vary the application of our principles; yet the principles themſelves continue to be of permanent, and of manifeſt, utility.

By this time, I flatter myſelf, the nature, and the effects, of ſhadows, as related to perſpective, have been ſufficiently illuſtrated: it is not the buſineſs of the LECTURE to apply them to ſpecific objects; for that I refer to the examples; and ſhall now offer merely a few thoughts on reflected appearances.

Had I been inclined to introduce here an eulogium on the ſcience of perſpective, I certainly might have congratulated myſelf on a happy opportunity, ſince the principles we have been diſcuſſing are cloſely allied to the ſublime; but I rather wiſh to impreſs on the minds of my auditory, an abiding conviction of their UTILITY. It is true, they are too much neglected and diſregarded; but I will be bold to ſay, no perſon poſſeſſing natural taſte, or liberality, after once acquiring them, would be induced to forget them. What ſhall we ſay, then, to the inattentive indolence of many artiſts, who omit to cultivate an acquaintance with them, or if acquainted with them do not ſcruple to violate their precepts?

In the article of REFLECTIONS (whoſe principles are extremely ſimple) this violation occurs very frequently; and, though nothing is eaſier, than to ſay, that the inferior appearance, or the counter-part, of an object, muſt not exceed in dimenſions, &c.

the object itſelf, yet this eaſy precept is too often neglected, or forgot.

When reflections of any kind preſent themſelves, conſider, that the angle of incidence and the angle of reflection are equal. As we ſtand before a houſe, for inſtance, we ſee the reflection of the ſun, appearing like another ſun, in its windows; what then is the true place of the heavenly luminary? It is juſt ſo many degrees of a circle diſtant from the direct aſpect of the window (whether ten, twenty, or thirty degrees), as our own ſituation. Or, bring the principle to the teſt of the mirror: although to ſee ourſelves we ſtand right before it and cloſe to it, yet, when ſtanding at a little diſtance from it, if we wiſh to ſee a particular object obliquely ſituated on the further ſide of a room, we muſt inevitably retire from the direct front of the glaſs, to a ſtation which correſponds with the angle made by that object with the glaſs; and this effect is the ſame, whether the ſpectator change his ſtation, or the direction of the glaſs be varied.

With regard to houſes, &c. ſeen in water, we continue, in idea at leaſt, the plane of that water, whereon we aſſume a line on which they are ſuppoſed to ſtand; or we trace by lines from the objects, what their ſeats would be; then we let fall perpendiculars from the principal parts of the buildings, which preſerve their original forms, tend to their original points, keep their original angles made with each other, and differ merely by being *inverted*: the procedure has little difficulty. The ef-

fects of reflection differ according to the nature of the reflecting medium; whether it be tranquil and clear, or agitated and diſcoloured; according alſo, to the variations of force in the objects, and to the ſituation of the enlightening luminary; but reflections, in general, ſhould always be *kept down*, or abated in their ſtrength, rather than permitted to diſpute with their originals.

Theſe principles, and their conſequences, I ſubmit, LADIES and GENTLEMEN, to your conſideration, and conclude my diſcourſe, by reminding you, that they are of daily utility, and may be brought to the teſt of daily experiment.

OBSERVATIONS

On the Plates belonging to LECTURE III.

PLATE XXXII.

No. I. Is intended to explain the nature of the ſeat of the light, and its effects as the rays diverge. The inſpection of the figure ſhews, that its principles are very ſimple; for having drawn, from the ſeat of the light, lines through the bottoms of the ſticks 1, 2, 3, 4, 5, 6; and, from the point of light, lines through their tops, the interſections of theſe lines give the lengths of the ſhadows; ſhort to ſome, and long to others, according to their heights, and to their appearances in perſpective.

The ſhadows of No. 5 and 6, being interrupted by the ſurface A, inſtead of continuing their courſe, receive a direction correſponding to that ſurface.

No. II. Is the ſame principle applied to ſolid bodies. The ſeat of the light being fixed, on the ground plane, from that point, as from a center, rule lines through the principal ſeats on this plane of the bodies whoſe ſhadows are required, as *a*, *b*, *c*, and from the luminous point rule lines touching the other extremes of theſe bodies, as *d*, *e*, *f*, *g*, the interſections of theſe lines give the extent of the ſhadows, as 1, 2, 3.

No. III. Shews the ſame principle, but the face of the object is enlightened, being beyond the luminary from the ſpectator.

No. IV. Needs no explanation.

PLATE

PLATE XXXIII.

Exhibits the ſeat of light on various planes: the candle is ſuppoſed to ſtand on the middle of the table, in which caſe, its ſeat on the floor, is found by the interſection of diagonals drawn from the legs of the table. A horizontal line, drawn through this center to the oppoſite ſides of the room, gives the points (as F) at which perpendiculars being raiſed will paſs through the ſeats of light on the vertical plane: a horizontal line from the point of light determines the exact ſeat, as at A and B. On the ſame principle, a line uniting the extremes of A and B on the ceiling, interſected by a line drawn from the luminary, as at D, gives the ſeat of light on the ceiling. To find the ſeat of light on the further ſide of the room, rule from the ſeat of light on the floor, to C (the center of the picture); where this line touches the bottom of the wall, erect a perpendicular, on which the required point is determined, by a line from the luminary to C, as at E: the ſame may be obtained by a ſimilar proceſs from D on the ceiling.

The ſhadows of all objects perpendicular to a plane, diverge from the ſeat of light on that plane. Thus the ſhadows of 1 and 2 on the ceiling, are found by the interſections of lines drawn from the ſeat of light, D, through their bottoms, with others from the luminary itſelf, through their tops.

The ſame is preciſely the effect of 3, whoſe ſhadow diverges from B.

The object 4 follows the ſame rules; and the ſhadows of its ſides, as *c*, recede from the ſeat of light on the floor. The ſhadow of 5 falls at 6, and, not being perpendicular but *parallel* to the plane B, the ſhadow of this ſide of the object 4 vaniſhes in C; as do the ſhadows on the ground of the ſides *a* and *b* of the table.

One inſtance of the utility of ſhadows appears in 5; which may, or may not, be united to 4, by its ſituation in the figure; but which is determined by the ſhadow at 6 to be affixed to it: while 7, which ſeems to be equally annexed to 4 (if we conſider its outline only), by its ſhadow is proved to be diſtant from it.

PLATE

PLATE XXXIV.

To repreſent ſhadows cauſed by the SUN, we muſt fix a point in the picture for the luminary, and, as its ſeat, a point on the plane on which the ſhadow is to be caſt: this is found, by letting fall a perpendicular from the luminary; whoſe ſituation with reſpect to the picture we ſhall quickly attend to.

No. I. R is a ray from the ſun; I the ſpectator's eye; of which J is the *ſeat*. The rays of the ſun being parallel, a line parallel to R paſſing through I gives T for the place of the ſun in the picture; a line from the *ſeat* of the ſun, through the *ſeat* of the eye (J) cuts the picture perpendicularly under T: produce this perpendicular, till it cuts the horizontal line, as at H, for the vaniſhing point of ſhadows on the ground.

C is the center of the picture: if the ſun was *perpendicular* to the plane of the picture, and of conſequence directly at the back of the ſpectator I J, the line H T would become union with the vertical line C G; as, if the ſun were on *this ſide* the ſpectator, the line H T would be removed toward L. If the ſun was *nearer the horizon*, the point T would be proportionally elevated toward H; or, if the ſun was *in the zenith*, it would be immediately over C G, and would occaſion no lateral ſhadow.

When the ſpectator is *between* the ſun and the picture, as in this example, the ſeat of the ſun on the picture, as at T, is *below* the horizontal line; but when the picture is between the ſpectator and the ſun, the ſun's ſeat on the picture, is of neceſſity above that line, as has been explained in the LECTURE.

No. II. In this example, the picture is between the ſun and the ſpectator: and the plane on which it is propoſed to find the ſhadow is vertical (as E.)

I is the ſpectator's eye; J its ſeat; R the inclination of the luminous rays; S the ſeat of the luminary on the ground; and S K the declination of the rays. F is an object perpendicular to E.

To prepare this picture, firſt draw J *h* parallel to S K, and at *h* erect a perpendicular; then draw I T parallel to R, cutting the line from *h* in T, which is the ſun's place in the picture. C is the center of the picture, through which produce a perpendicular, as D *d*, which is the vaniſhing line of the perpendicular plane E. Draw T D perpendicular to T *h*, then is D the ſeat of the ſun on the vertical line, and the vaniſhing point of ſhadows on that plane; as H is, on the horizontal line.

PLATE

PLATE XXXV.

No. I. Figure 1. To the foregoing example, this adds the method of finding the ſhadow on a plane *inclined* to the horizon, but perpendicular to the picture.

The firſt part of the proceſs, is exactly as the foregoing: I the ſpectator's Eye; J its ſeat: R the luminary; S its ſeat; S T the declination of the rays: procure the point H as before, by drawing from J to the picture a line ſtriking it beneath *v*, from whence erect a perpendicular, and from I draw (parallel to the original ray) I *r*: erect at C a vertical line, which, cut by one perpendicular to it from *r*, gives D for the ſeat of the ſun on the vertical plane.

Now to procure the vaniſhing points for the ſhadows on the inclined plane Y; through C draw C V, (correſponding to the direction of the plane Y) cut by *r* D at V; which is the vaniſhing point for the ſhadows of horizontal objects on Y. The line V C continued till it interſects *r* H, (as at *v*) gives *v* as the vaniſhing point for ſhadows of vertical objects on Y.

Of the ſhadows in this example, *p q* tend to H; being on the horizontal plane: *k*, ſhadow of *g*, tends to D; being on the vertical plane: *o*, ſhadow of *e*, tends to V; being horizontal on the inclined plane: and *z* being vertical, its ſhadow *y* on that plane tends to *v*.

Figure 2. Shews the ſyſtematic lines, freed from objects and ſhadows, and in their proper bearings as ſeen *direct*. The references are the ſame.

Suppoſing the foregoing figures ſufficient to explain the general principles of ſhadows projected either by a lamp, or by the ſun, we proceed to notice the application of theſe principles to illuminated objects.

PLATE

PLATE XXXVI.

WHEN THE SUN IS IN THE PLANE OF THE PICTURE.

Figure 1. H L is the horizontal line. The ſhadow falls to the right hand. The rays of the ſun being parallel, we muſt in the firſt place determine its elevation in the heavens, and aſſume the direction of its rays accordingly, as R. The ſun being in the plane of the picture, the ſhadows it occaſions are parallel to the ground line, ſo that we need only procure their lengths by interſections parallel to thoſe rays.

From the bottom of the houſe, A, rule a line parallel to the ground line; to cut this line for the ſhadow of B, rule from B a line parallel to the radial line, as R B, which gives *a* for the ſhadow of B.

The ſide B, F, vaniſhing in L, ſo does its ſhadow *a f*: or, the point *f* is equally found by ruling a horizontal line from the ſeat of F, cut by a radial parallel to R.

Figure 2. The ſame proceſs; the ſhadow falling to the left hand. Rule A 1, horizontally, which is cut by the radial B 1; let fall D to C; rule C 2 horizontal, which is cut by the radial D 2. Rule E 3, horizontal, which is cut by the radial F 3: unite 1, 2, 3, to complete the ſhadow of B, D, F. 3, ruled to L, gives the ſhadow of the further ſide of the roof of the houſe.

PLATE

PLATE XXXVII.

THE SUN BEHIND THE PICTURE.

No. I. In this ſubject, the place of the ſun in the picture, is beyond the limits of the picture; but its half elevation is marked, as S. The place of the ſun being determined, alſo its ſeat on the horizontal line as H, rule S B, S C, S D, S E; let fall D to *d*; then from H rule for the interſections H A, which gives 1 for the ſhadow of B; H *c*, which gives 2 for the ſhadow of C; H *d*, which gives 3 for the ſhadow of D, H *e* which gives 4 for the ſhadow of E. Unite 2, 3, 4, to complete the ſhadow of C, D, E.

THE SUN BEFORE THE PICTURE.

No. II. Firſt determine the ſeat of the ſun, as S, and its ſeat on the horizontal line, as H, rule to S, from B, C, and D, let fall C to *c*; interſect theſe lines by others to H, as A H, which gives 1 for the ſhadow of B; *c* H which gives 2 for the ſhadow of C, &c.

Such are the general principles of ſhadows occaſioned by the ſun, in which we are to obſerve, firſt, the parallelism of the ſun's rays; ſecondly, the place of the ſun, and the direction of thoſe rays; thirdly, the ſeat of the ſun on the horizontal line, for the ſhadows of objects on the horizontal plane, or on the vertical line, for the ſhadows of objects on the vertical plane; and ſo of any other plane, as already ſhewn. We ſhall add a few examples of other objects.

PLATE XXXVIII.

IN THESE EXAMPLES, THE SUN IS BEHIND THE PICTURE.

H L is the horizontal line; C the center: ſuppoſed to be *out of the picture* immediately above L (as may be found by tracing the radial lines) is the place of the ſun, conſequently L is its tranſpoſed ſeat on the horizontal plane.

No. I. Is a cube with one face parallel to the picture: 1 is the ſhadow of A, 2 of B, 3 of D; as B D vaniſhes in C, ſo does its ſhadow 2 3, being parallel to it.

No. II. Explains the ſhadow of a croſs: the ſeat *b d* of the croſs-beam (B D) is found by letting fall perpendiculars which are cut by a line from C, through the bottom of the croſs. Radials are ruled from the principal parts, as A, B, D; and interſected by lines from L, through the ſeats of thoſe parts, as 1, 2, 3, &c.

No. III. Shews the paſſage of the ſhadow over a block lying along; the block vaniſhes in C; the line deſcribing its *further* ſide at bottom, being drawn, the ſhadow of the croſs is traced to it, it mounts directly up that ſide, and appears again on the ſurface, where it recovers its former courſe. The ſhadow of the end of the block, at 4, 5, is found by the ſame method as in No. I.

No. IV. Is a cube, whoſe ſhadow is found by ruling, from the place of the luminary, lines through its upper corners, as *a b*; which are interſected by lines from its lower corners drawn to L, as 1 L, 2 L: this ſhadow, 1. 2. being parallel to the ſide *a b*, tends to the vaniſhing point of that ſide.

No. V. To find the ſhadow of a cylinder, ſelect three or four points in its upper ſurface, *a b c d*; find their ſeats at the lower ſurface, by letting fall perpendiculars; rule radial lines, from the upper ſurface: and from L, the ſeat of the luminary, rule through the correſponding points below, till they interſect the former, as 1 2 3 4: unite theſe carefully to complete the figure.

PLATE

PLATE XXXIX.

IN THE FOLLOWING EXAMPLES THE SUN IS BEFORE THE PICTURE.

H is the *ſeat* of the ſun on the Horizontal Line.

A is the vaniſhing point of the rays of light; or, the ſuppoſed place of the ſun on the horizontal plane.

No. I. Is a cube erect; the lines from its upper corners are ruled to A, as *a b*; thoſe from its bottom corners, are ruled to H, as *c d e*: their interſections determine the ſhadow, 1 2 3.

No. II. Is treated on the principles of No. II. in Plate XXXVIII. by finding the ſeat of its extremes, and ruling radials to A, as *a* and *c*; interſected from H as *b* and *d*.

No. III. Is an application of the ſame method to a flight of ſteps; whoſe bottom corner, *c*, is ruled to H, and the top of the ſame ſtep to A, interſecting at 1. The ſeat of the ſecond ſtep is found at *b*, which, ruled to H, is cut at 2; the ſeat of the third ſtep is at *a*, which is cut at 3; 4 is the interſection of the ſeat of the *further* end of the ſame face, which is found by letting fall a perpendicular from *g*, interſected by *a* C; in the ſame manner, is found, the ſeat of *t*; which likewiſe ruled to H, completes the ſhadow on the ground. The ſhadows of the higher ſteps on the lower are alſo ruled to H.

The ſhadow of the ſtick A is ruled to H, till it meets the ſtep, whoſe perpendicular courſe it then follows; on the horizontal part of the ſtep, it is again ruled to H; the ſhadow of its head, ruled to A, completes the whole.

PLATE XL.

IN THIS EXAMPLE THE SUN IS BEFORE THE PICTURE.

R, ſuppoſed place of the ſun; H, its tranſpoſed *ſeat* on the horizontal line.

The ſhadow of the cylinder is ruled to H.

The ſhadow of the board on the top of the cylinder, and which falls on the cylinder, is found, by ſelecting as many points as are thought neceſſary between A B and B C; as at B; rule B H; where it touches the top of the cylinder, let fall a perpendicular; where that is interſected by a line from B to R is the ſhadow of B, as at L. The ſame for any other point, between A and B.

The ſhadow of the board on the ground is found by procuring its ſeat, as of A B C, at *a b c*; which are ruled to H. The ſhadow of the wire *e* on the cylinder is found by ruling its ſeat *d* to H, ſtriking the bottom of the cylinder in D; then erecting a perpendicular, which is cut by *e* R at E, for the place of the ſhadow of *e*: the ſame method procures G and F.

This figure exemplifies the method of treating columns, &c. in architecture, the ſhadows of ſquare mouldings, &c. when they fall on columns, &c.

PLATE

PLATE XLI.

No. I. Shews how to find the ſhadow of a globe enlightened by the ſun: here we may obſerve, that the ſhadow of a globe is ſimilar to that of a circle *directly* oppoſed to the luminary; by finding therefore the ſhadows of certain points in its circumference ſo oppoſed, we obtain the whole. R is a ray of light; V the center of the picture; 1 2 3 4 is a ſuppoſed ſection, deſcribing the enlightened part: procure the ſeat of this circle on the ground, by perpendiculars, as 1 *a*, 2 *b*, 3 *c*, 4 *d*; rule lines parallel to R, from 1 2 3 4 for the ſhadow; and lines parallel to the ground plane from *a b c d*: their interſections aſcertain the ſeats of the ſhadows of thoſe points (1 2 3 4) in the original ſection; which, being joined, conduct the reſt of the ſhadow of the circumference.

No. II. Is a globe enlightened by a lamp: now as the luminary is ſo near to the object, a much leſs portion than half the circumference is alone capable of receiving light. We have to ſuppoſe a ſimilar ſection as before; 1 2 3 4; find their ſeats on the ground, by perpendiculars, as *a b c d*; rule L 1, L 2, L 3, L 4; and from the ſeat of the light S, rule interſections, as L 1 in *e*; L 2 in *f*; L 3 in *g*; L 4 in *h*. Theſe points, united, indicate the ſhadow of the original ſection. Y is the center of the picture.

PLATE

PLATE XLII.

No. I. In this example we have a wall (G), and, at right angles with it, another wall, with a doorway in it. H L is the horizontal line; the ſun is ſuppoſed in the plane of the picture; the inclination of its rays, to be R H.

Firſt, from the bottom of the projecting wall, rule a horizontal line to the bottom of the wall G; where erect a perpendicular, which, cut by a line from *a* parallel to R H, gives *u* for the ſhadow of *a*, which unite to *t*. Or, rule from R, *t u*, which equally gives the ſhadow of the top *t a* at *u*: *c* and *d* are exactly ſimilar.

The ſhed D is ſhewn more diſtinctly in the following Number; the ſyſtematic lines are the ſame.

No. II. The wall B (to which the ſide of the ſhed *w s* is parallel) vaniſhes in L.

The wall A vaniſhes in H, the roof of the ſhed in G; T repreſents the inclination of the rays of light.

Firſt, draw A *w*, where erect *w s*: then draw R through *t*, ſtriking the top of the ſhed in *u*; there remains now only that part of the ſhadow which falls on the roof. Rule G through *u*; interſect it by a line from *a*, parallel to the rays of light, as at *r*, which unite to *s*. Or this part of the ſhadow may be found, by ruling Q *h*, cutting A *h* in *h*; then rule *h s r*.

PLATE

PLATE XLIII.

Repreſents a houſe ſtanding oblique to the picture. H L the horizontal line. The ſun is in the plane of the picture; and his rays parallel to V H.

One ſide of the houſe (G) vaniſhes in H, the other in L: theſe are too obvious to need explanation. The roof is ſuppoſed pyramidal, and a pyramid ſet on a cube is the ſame as if ſtanding on a plane. *Vide* No. II. Plate XXI. Rule therefore diagonals to find its center, which is at A, where erect its axis A O, and to O draw its ſides.

To repreſent the garret window; erect *a c*, and ſuppoſe *b* the height of the hole made in the roof; draw *a* O, then *b* H *c* H interſecting it: ſuppoſing *m* and *x* the extent of the window, erect there perpendiculars; theſe, cut by a line from *b* to L, give the ſquare, and, united at *c*, the roof of the window.

To find the ſhadows caſt on the roof of the houſe; lay a ruler from T through A ſtriking the horizontal line in X; erect X D perpendicular to H L, and continue T O, till it meets that line above D: rule D L, which is the vaniſhing line of the plane T O R, interſecting the plane of rays in Y, which is a vaniſhing point for the ſhadows on the roof. The ſhadow of the window is found, by ruling *f* Y, which interſected by a parallel to Y H, from the neareſt corner of the top of the window-ſquare, gives *i* for its termination. On the ſame principle the ſhadow of B is found: rule Y P R, which interſected by a line parallel to V H from B, gives R for the ſhadow of B. The ſhadow of the roof on the chimney is found, by continuing to the top of the roof the line where the chimney and the roof meet, as at *t*; through *t* draw V *t n*; or a line through *w*, parallel to V H, will ſtrike the chimney in *n*. The figure M ſhews the chimney more diſtinctly; and that its conſtruction reſembles that of the window.

PLATE XLIV.

Explains as well the manner of finding the ſhadows of theſe objects, as their reflections. C is the center; H the vaniſhing point of the rays of light, i. e. the ſeat of the ſun on the horizontal line.

This figure is a hollow cylinder cut open, its hither end parallel to the picture. To repreſent its ſhadow on the ground; find the ſeat of 3, as at 5, rule this to H, then rule 3 to M, their interſection gives the ſhadow. The ſhadows of the other corners are found by the ſame method. For the ſhadow of the edge on the internal hollow, rule *a r*, *b s*, *c t*, parallel to C M; then rule *r s t* to C, and *a b c* to M; their interſections deſcribe the courſe of the ſhadow. The object being parallel to the picture, is perfectly circular, as alſo its reflection W.

The reflection of K is found merely by inverſing its height as at *k*, the plane of the water being ſuppoſed to be continued.

The ſhadow of K on the cylinder, is found thus: from any point in the outer circumference of the tube, as 2, draw 2 C; then find the ſeat of 2 on the ground, as at *g*, rule this to C; and where it is croſſed by the ſhadow of K ruled to H, as at *f*, erect a perpendicular, interſecting 2 C at *q*, for one ſide of the ſhadow: as *u* gives *y* for the other ſide of the ſhadow. To continue the courſe of the ſhadow, take another point on the circumference as *r*, find its ſeat, rule it to C, erect a line, &c. as before, and it gives S by its interſection with *r* C.

The ſhadow on the inſide of the cylinder is found as before; parallel to C M rule *a t*, and *b l*; rule *t* C, *l* C, which interſected by *a* M, *b* M, give *n m* for the courſe of the ſhadow. To find the ſhadow of this object on the ground; procure the ſeat of 1 as at *h*; rule *h* H, and 1 M; their interſection is hint ſufficient. The reflection is merely a counterpart.

PLATE

PLATE XLV.

No. I. Shews the reflection of houſes, &c. in water, whoſe principles are extremely ſimple. Procure the ſeat of the objects, and invert their perpendiculars as much below that ſeat, as they appear above it: ruling their perſpective lines to the ſame points as the originals. Thus, *a* is the reflection and counterpart of A; but there being no reflecting medium between B and the ſpectator, B cannot appear inverted. *d* Is the reflection of D; 2 of 1, 4 of 3, and *e* of E: theſe all vaniſh in C. F vaniſhes in I, and ſo does its reflection *f* of courſe.

PLATE XLVI.

No. I. Shews that however the rays from objects, &c. and their reflections may appear to differ, yet in reality they are exactly ſimilar: ſo that, the ſuppoſed reflective depth in the water of C D, and E F, is equal in appearance to the diſtance between thoſe objects and the radial interſections.

No. II. If the little figure ſtanding on the hill, be ſuppoſed to wiſh to repreſent the reflections, &c. of theſe houſes, he would be able to ſhew but a ſmall part of them, as in fact he ſees little beſide the houſe E and the tower D.

No. III. Exhibits a variety of objects whoſe reflections explain themſelves, being exact counterparts. Of the ſticks D, and E, the firſt being upright, its reflection is upright alſo: but E being aſlant, that part of it which is under the water, becomes *refracted* by the denſer medium, and ſeems as it were broken, ſo that though it is a good rule to conſider water as a mirror, yet by its tranſparency and refractive powers, it ſometimes differs in its effect.

LECTURE IV.

LADIES and GENTLEMEN,

WHILE on every ſubject there may be various, and often, contradictory, opinions, according to the aſpects under which it is ſeen by different perſons, we need not wonder, that on the principles of art, and on their application, the ſentiments of profeſſors ſhould ſometimes diſagree. This happens occaſionally on the ſtudy of perſpective: while ſome maſters deſpiſe that eye which does not (alone) ſufficiently aſcertain the natural appearances of objects, others think geometrical ſcrupuloſity is indiſpenſible, in every repreſentation of nature. Shall I ſay that, both theſe extremes are to be avoided? or, ſhall I rather commend them both, and adviſe to unite them? Geometry alone never yet compoſed a happy, and pleaſing, picture; and if the effuſions of practice, unregulated by juſt theory, may have attained to veracity and correctneſs, I have not been ſo fortunate as to meet with ſuch inſtances.

But, of late, ſince ſcience is aſhionable, and every offered aſſiſtance is generally received with avidity, it is much more common for artiſts to depend on the dogmas of ſcience, than on the obſervation of Nature;

Nature; inſomuch, that geometry has been conſidered as the ſovereign, rather than as the aſſiſtant of Perſpective; and becauſe, hereby we procure ſuch and ſuch repreſentations of objects, it has been aſſerted (ſomewhat prematurely, as I ſuppoſe) that theſe repreſentations are concluſively accurate, and demonſtrative.

I flatter myſelf, not any of my auditors whom I have had the honour to addreſs in the preceding Lectures, will entertain a thought, that I am inſenſible to the advantages ariſing from mathematical aſſiſtance, or that I undervalue our obligations to that ſcience, which alone has afforded, or can afford, certainty and exactneſs to the ſtudy of perſpective; and yet I cannot entirely acquieſce in attributing abſolute puiſſance to geometrical inductions: nor do I think ſuch aſſertions would have been made by writers on perſpective, if they had extended their views, and conſidered NATURE as the ſupreme authority throughout the imitative arts.

But, ſince I avow this ſentiment, I requeſt your indulgence, while I notice ſome differences between the effects of geometry and thoſe of perſpective; or, rather, I ſhall offer remarks on a few particulars, in which the rules of both ſciences are inadequate to the requiſitions of art.

To define perſpective, perhaps I ſhould call it a regulated imitation of Nature; in which imitation it receives much aſſiſtance from geometry: but, in ſome inſtances, geometry is quickly ſuper-

ſeded, and even perſpective fails in its application. We have already obſerved, that ſome articles are too minute, or too trivial, to engage the attention of perſpective: others depend not on mathematical rules, but on the operations of Nature at large; a reference to which, will not, I hope, be deemed impertinent. Should we requeſt a geometrician to determine the boundaries of an extenſive proſpect, he would not only find the undertaking more difficult than he expected, but even abſolutely impoſſible to ſtrict geometry: for, by geometry he would *prove*, that the height of a man being ſuppoſed five feet, the extent of his viſion ſhould be confined by the horizon at about the diſtance of three miles, on level ground: whereas, we really inſpect much farther; becauſe the ſame principle which occaſions twilight (I mean the refraction of the air) elevates apparently the diſtances of the proſpect before us, and renders them viſible to us, although in fact they are geometrically *below* our horizon: much after the ſame manner as a piece of money at the bottom of a fit veſſel is rendered viſible by the acceſſion of water.

It is not ſeldom this fact can be demonſtrated on land, but at ſea it is of perpetual utility; for, hereby the tops of hills and lands are raiſed up in the air, ſo as to be diſcoverable ſeveral leagues further off, than otherwiſe they would be: and this refractive power in the air, is more ſenſible according to the greater diſtance wherein it has to act, and the quality of thoſe vapours it contains: to the very great benefit of ſome parts of our globe.

"Very

"Very far North," ſays Captain JAMES, who wintered up Hudſon's Bay, "we found the ſun to riſe twenty minutes before it ſhould, and in the evening, to remain about twenty minutes longer than it ſhould"—and this refraction ſhortens the polar winter a whole month; as well as prolongs every day the cheerful ſight of the ſun in thoſe parts.

The refractive power of the air, has alſo a remarkable effect on the form of the ſun, and the moon, when near the horizon, changing them, from the circular form of which we know they ſhould be, to an oval form, and, eſpecially, raiſing (and thereby flattening) the under limb, ſo much, that the general form of the object is of no true mathematical figure: this I myſelf have obſerved in a conſiderable degree: though I ſuppoſe no degree which ever occurs in this country, can equal what often occurs in the north.

But not to one region only is the principle of aerial refraction confined, for, in the warmer climates of the eaſt it has its influence. Dr. SHAW, ſpeaking of Arabia round about Mount Sinai, informs us, that when theſe deſarts are ſandy, and level, the horizon is as fit for aſtronomical obſervations as at ſea, which at a diſtance theſe parts nearly reſemble. It was there ſurpriſing, to obſerve in what an extraordinary manner every object appeared to be magnified; for a ſhrub ſeemed as big as a tree, and a flock of Achbobbas (birds the ſize of a Capon) might be miſtaken for a caravan of camels. "This,"

ſays he, "ſeems to advance about a quarter of a "mile before us."

My auditory will readily perceive, that in order to render this obſervation ſenſible, and evident, I have ſelected inſtances more remarkable than our temperate climate affords; but, ſuffer me alſo to add, that we are not without effects ariſing from this cauſe, which are more conſiderable in ſummer, than in winter, and perhaps at the morning, than at the evening, twilight.

To apply this to the ſubject of our immediate attention, I think I may venture to ſay, not only that we ſee remoter objects than, geometrically, we ought to ſee, but alſo, that objects ſituated at ſome diſtance from us, appear larger and more diſtinct, than their geometrical ſituation would indicate.

Moreover, I cannot help thinking, that, in ſtructures of very great extent, this principle has its effect; and, that the remoter parts of ſuch ſtructures are not always ſo greatly diminiſhed as geometry would determine, or, as we ſee them repreſented; for, if they were, ſuch ranges of buildings as—the palace of Perſepolis, or—as ſome of the Italian aqueducts, or—as even ſome of our own ſtreets, would be nearly inviſible at their further ends. Neither, in my opinion, are the diſtances always ſo evaneſcent; for, not only in dimenſions, but in effect, the rules of geometry are occaſionally evaded by objects, as it does not always happen, that, their force decreaſes according to their geometrical diſtances;

tances; but, by a variety of accidents, arising from the vivacity of the light, or from the rarity, or the denſity, of the circum-ambient air, they vary conſiderably from their preſcribed effects. Nor indeed is perſpective itſelf infallible here; for, if we ſuppoſe ourſelves to have taken the moſt accurate view (of a diſtant town for inſtance) while the ſun has been obſcured by clouds, ſhould they be ſuddenly diſſipated, and the ſun ſhine full on that particular ſpot, it would ſcarcely ſeem the ſame place which we had been deſigning: or, perhaps ſome gilded weathercock, juſt moved by a little ſhift of wind, may gleam irregularity into the *keeping* of the piece: or ſome white object may ſo far ſurpaſs its neighbours, as to be extra-diſtinguiſhed among them. I have often noticed houſes at a diſtance, perhaps, barely ſufficient to aſcertain them, or their forms, when ſuddenly, by the parting of clouds, the ſunbeams have been reflected with great ſplendor, even from windows which before were imperceptible. This often happens in the evening, to houſes built on hills, and to other objects which are highly elevated: in fact, the article of light is among thoſe leaſt ſubject to rules, and while it is undoubtedly an indiſpenſible ingredient, it is perhaps the moſt deceptive of any in a compoſition.

Is this an advantage, or a diſadvantage? An advantage, very certainly, to thoſe who know how to improve it; for, as the variety of accidents which ſudden tranſitions of light occaſion, is endleſs, it furniſhes

niſhes innumerable opportunities for ſelection, and for choice, to whoever has ſkill to chooſe aright.

You muſt often have noticed this:—while the ſky has been darkened with clouds, ſometimes they would ſeparate, and permit a broad paſſage for the ſun-beams; then, gradually cloſing, they have contracted the illumination to a mere ſpan; and the effect of this light has been various, according to the objects whereon it has fallen; whether on fields, on meadows, on waters, on towns, on gilded turrets, or, on humble thatch: whether on barren waſte, or on cultivated land; on woods, on parks, or on corn fields. Which latter objects, be it obſerved, have, when agitated by the wind, an agreeably graceful movement peculiar to themſelves, in the gradual bending, and waving, of the golden grain; to which effect the light very much contributes. If to the idea of clouds, and their intervals, you add that of a briſk wind, impelling them in rapid ſucceſſion one after another, you may eaſily imagine its effect on the light, and the perpetual change of illuminated appearances reſulting from this alternation; every object being by turns enlightened, and darkened; now reſplendent, now gloomy; preſently emerging from obſcurity into demi-tint; or from demi-tint becoming obſcure.

It is, nevertheleſs, very certain, that theſe accidents, although exceptions to general rules, by no means ſuperſede their utility: they only prove that Nature offers an infinite variety for our amuſement, our

our recreation, and our ſtudy. Happy the Genius, whoſe enlightened ſkill attains to an agreeable imitation of them! Happy the Artiſt, whoſe works, inſtead of tedious ſimilarity, preſent thoſe ſtriking, and energetic, compoſitions, which are viſible alone to the ingenious, and to the well-informed!

This may be a proper place to enquire by what principle ſome objects, or ſome parts of an object appear to advance, and others to retire. It is, becauſe the light from that part of a ſurface neareſt to the eye, has ſo much greater force than that from the further end of the ſame ſurface: this effect, although dependent on the principles of perſpective, is yet very much changed by the obliquity of a ſurface, by the ſituation of a luminary, or by the nature of an object; all which cauſes vary the degree, and the force of reflection.

In looking at this mahogany table, the hither part of its ſurface, that adjoining the edge neareſt to us, ſeems enlightened; this light at a very ſmall diſtance indeed, becomes moderated; a little further off, it is yet more decreaſed, and, as we advance toward the other extremity, it ceaſes to be light, and may rather be denominated a ſlight ſhade. This effect is very gradual, regular, and conſtant, becauſe the ſurface is uniform; and, conſequently, its obliquity or declination from the eye is uniform alſo: but, if in any part of the table we place a ſurface ſomewhat more elevated in its poſition (as this drawing-board) the neareſt edge of that ſurface does not perfectly correſpond in its degree of light with that

part of the table where it is placed, but the light is ſome degrees brighter, and, as it were, ſets off afreſh on this new ſurface from its hither end, gradually decreaſing to its further end; the waving of grain in a corn field, whoſe agreeable movement we have noticed, depends much on this: the various directions of the undulating ſurface, perpetually diſtinguiſhing themſelves, by breaking the uniformity of the general plane.

But, if inſtead of a flat ſuperficies, we obſerve this circular ſilver vaſe, the gradation of tint is much more rapid, and from the brighteſt light to the ſtrongeſt dark, is but a ſmall diſtance, in proportion to the circumference of the object. The brilliancy of poliſhed metallic bodies depends entirely on this principle; which, however regular in itſelf, is too much diverſified in its objects, to ſubmit to the rules of perſpective; ſince the forms of objects (which greatly contribute to this effect, and correſpondently vary its power) are infinite. This principle, together with an accurate underſtanding, in the article of reflections, is among the higher Studies of Art; and, when happily applied, nothing more deciſively demonſtrates ſuperior abilities, or the GREAT Maſter: for not only veracity, and I may add deception, depend on them, but alſo harmony, and repoſe.

A word, or two, on the Article of REFLECTION in ſhadow, may, here, with propriety, receive our attention.

I know not how better to explain this article, than by recollecting the order in which we have traced

traced the retiring ſhade: correſpondent thereto, obſerve, that, the neareſt end of any ſurface which is in ſhadow, ſeems more deeply ſhaded than the further end; the ſhadow in receding being weakened, as it were *diluted*, by degrees, and becoming lighter, and lighter. The very gradual diminution of the force of the ſhadow prevents this from being conſpicuous in adjacent parts; but when we compare the extremes, it appears unqueſtionable. The reſult is, that a greater ſtrength of light, accompanied by a greater ſtrength of ſhade, brings forward thoſe objects to which it is applied; while a correſpondent privation of both, or, mutual advances toward each other, produce the appearance of receſſion, and diſtance.

The cauſe of this is, perhaps, not very difficult to aſſign; for, if we conſider, that the rays of light are perpetually diverging in every poſſible direction, it follows, that in a more extended ſpace, there is room and opportunity for the action and the effect of a much greater number of ſuch rays, than there can be in a leſſer ſpace; therefore, although by its nearneſs to our ſight, the hither end of a plane ſurface appears dark, yet, while the air is illuminated, it interpoſes ſo much of its illumination between the diſtances of that plane and our ſight, as prevents the ſhadow from arriving at our eye with equal ſtrength. Thus it appears, that the air moderates, and diminiſhes, the reſplendence of light, and that it has the ſame effect alſo on the obſcurity of ſhadow, endeavouring, as it were, to impart its

own colour to both: and this endeavour it accompliſhes, in a ſpace ſufficiently extenſive; as appears by the azure colour of diſtant mountains, and in other particulars. This reaſoning is ſtrengthened, by remarking, that when the air is deprived of light, every object, diſtance, figure, and form, is concealed and diſappears.

The foregoing analyſis may be adapted, not only to objects deprived of light, but alſo to ſhadows themſelves; which, by increaſed diſtance from their origin, and cauſe, become leſs determined, and leſs forcible. When the extremes of a ſhadow fall on a ſuperficies, near to the ſhadowing cauſe, the outline, and the form, of the ſhadow is very accurately defined, and repreſented; but, when the object intercepting the light, is at ſome diſtance from the ſuperficies whereon the ſhadow falls, the extremes are confuſed, weak, and indeterminate; becauſe the rays of light have more power, and are more in number, are more reflected and refracted, as the interval is increaſed.

The article of ſhadows is very important; under good management, they contribute greatly to diſtinguiſh diſtances, and to ſeparate objects even though related in colour: for inſtance, if two walls, of equal height, one behind the other, have but a little ſpace between them, they may poſſibly ſeem a continuation of each other; but, if the direction of the light be in the ſame plane as the walls themſelves, it will ſhine *between* them, and, by this effect, part them: or, if the ſhadow of one falls upon the

the other, it will equally imply a ſeparation, and diſtance, between them.

When a ſhadow is of conſiderable extent, the objects which are immerſed in it, are not enlightened from the ſame quarter as the object caſting the ſhadow, but by reflections from the oppoſite quarter; ſo that, the lights and ſhadows are ſituated *reverſely*. A perſon ſtanding under the ſhadow of a high wall, which ſhadow falls to the left, will receive a reflected light from the left, and he will caſt to the right a ſhadow on the wall, againſt which he ſtands: always ſuppoſing no impediment to be interpoſed, but the air to be free.

Reflections are very much confuſed, and intermingled, by partaking of luminous rays emitted from other bodies; and, eſpecially, if the reflecting object be near the ſhadow, it very ſtrongly enlightens it: as that Lady's white dreſs reflects ſo clearly on the ſhadowed flap of the table, as to *whiten* the ſhadow.

Theſe particulars, and many others which are allied to them, are by no means proper ſubjects of perſpective regulation; they muſt be ſtudied from Nature; as muſt alſo the reflections of colours; for every colour emits rays according to its tint, and theſe rays colour (or rather, perhaps, diſcolour) other objects on which they fall. Thus, when a group of ladies ſtand together, the white dreſs of one will receive a tinge from the coloured dreſſes of the others: from a pink, it will become pinkiſh; from a green, greeniſh, and ſo on: while, like a ſociable neighbour, it returns the compliment, and renders

renders whitiſh thoſe parts of the coloured dreſſes which are neareſt to it. On the ſame principle, when the ſun ſhines on a red carpet, the reflection from the carpet will tinge the ceiling with a reddiſh hue, and the carpet will receive a whitiſh tint from the ceiling in return.

It may be worth while, juſt to obſerve here, that we conſider the reflection as equal to half the direct ray of light, in force, and the re-reflection as equal to half of the firſt ray; thus, diminiſhing half its ſtrength continually, it ſoon becomes too feeble to claim our regard.

It is not very common to conſider theſe principles as forming part of perſpective, yet, as they ſeem to me to be very cloſely allied to this ſcience, I have ventured to introduce them; and, perhaps, if greater attention to the effects and appearances of Nature, were more commonly introduced into treatiſes on the ſubject, the reaſonings, and the illuſtrations, to which ſuch appearances give occaſion, might relieve, and entertain, as well as direct, and inſtruct, the Student, to great advantage.

After having in ſome particulars ſpeculated, as it were, on extenſive, and remote, effects, I ſhall now, requeſt attention to what more immediately belongs to ourſelves; for, after we have inveſtigated objects of every kind, we nevertheleſs, return with peculiar complacency to the human figure.

We have, on former opportunities, noticed the proportions, the movements, and the appearances, of the figure; and the principles we then illuſtrated

and

and adduced, are unqueſtionably of great utility: but, by this time, I may venture to hope, that we are prepared to regard them alſo as influenced among other cauſes by Perſpective. An inanimate ſubject, being void of motion, may be meaſured to the utmoſt nicety, and the correſpondence of its parts may be determined, minutely; but in a ſubject perpetually ſhifting its ſituation, and varying its forms, if we fall ſhort of this accuracy we are not to be ſurprized. Not that I am about to undervalue the moſt correct and accurate meaſurements to which the human figure and its parts have been ſubjected, but, merely to notice ſome circumſtances ariſing from perſpective, of whoſe effects it is of importance to be appriſed.

When I ſtretch out my arm to its full extent, that perſon to whom it happens to be in a ſtrait line, ſees, properly ſpeaking, little of the arm; but, the hand might, for aught that appears to him, be united immediately to the ſhoulder. This, is an extreme inſtance of a principle denominated *foreſhortening*. The ſame may be the ſituation of the leg: and, in fact, all the members are capable of it from joint to joint, in a greater, or a leſs, degree. To comprehend this more fully, we have only to ſurvey a plaſter figure; and we ſhall find as we move around it, the members aſſume an infinite variety of aſpects. Suppoſe it, for inſtance, to be a figure kneeling, in which caſe the leg from the knee to the foot is parallel to the ground; on one ſide of this figure we ſee the whole leg at its full extent, but by walking round it a little, the diſtance between the knee and the

the foot ſeems, gradually, to leſſen, and leſſen; till, at laſt, the further parts are greatly concealed by the nearer parts: or, at leaſt, they appear receding, and, as it were, flying off.—This is evidently an effect of Perſpective; but this is reducible to no laws, whoſe application is determinable, ſince what may apply to one member, or to one attitude of a member, may not ſuit another member, or another attitude.

Foreſhortening is, perhaps, of the greateſt conſequence, where, only, this flying off, or receſſion, is to be repreſented: and ſuch inſtances are perpetually occurring; no attitude can be without them in ſome of its parts: the principle runs through every member of the figure, and, according to the dimenſions of a member is more, or leſs, apparent. Thus, the arm laid on the table, is foreſhortened (to a ſpectator) from the wriſt to the elbow; the fingers are foreſhortened in ſome reſpect, or other, be the poſition of the hand what it may. In our imitation of this effect, beſide accuracy of outline, the application of that retiring ſhade we have noticed, is principally to be depended on: for, by its influence in moderating the brilliancy of the parts foreſhortened, it ſeems to increaſe the vivacity, and the force, of thoſe where the light ſtrikes; as, the front, principally: or, wherever the parts receive another direction, as in the already exhibited caſe of the drawing-board; ſo that, it appears, foreſhortning and the retiring ſhade are ſo cloſely allied, that where one acts as a cauſe, the other follows as an effect.

As

As extreme inſtances of foreſhortening — Perſpective has been applied, with very powerful effect, to figures placed in particular ſituations; ſuch as, high up on the ſides of large halls, or other great rooms, on ceilings, and on other planes, not vertical to the eye in its uſual exerciſe. That ſome of theſe ſubjects are ornamental, I ſhall not deny; but, that they are always well-choſen, is more than I incline to aſſert. We have inſtances of figures repreſented in ſuch ſituations (as on a narrow projection; at the height of an hundred feet or more) that the firſt ſentiment they raiſe in a ſpectator is, that of fear,—for ſhould they fall, the fall would be fatal. We have inſtances alſo of naval triumphs, and, connected with them, of daſhing waves, on the coving entablatures of ceilings: ſurely the eye muſt be pardoned, if the firſt emotion it ſuffers from ſuch repreſentations, is, wonder how the ſea ſhould come there, and how it ſhould there abide! To be ſure, when an artiſt has taken the trouble to make a ſea, whether ſtormy or calm, he may claim a right of putting his ſea where he pleaſes; but we may be allowed to wiſh, inſtead of exerciſing his right, he had exerciſed his judgment; then had he pleaſed not himſelf only, but alſo judicious ſpectators.

Ceiling pieces are, however, the great inſtances of perſpective foreſhortening, &c. in figures; and there are many examples in which ſuch principles are very happily applied; but, this is not the only ſpecies of art, in which, after a great maſter has

originated, and applied, a new principle, his imitators have carried it to exceſs. The immenſe concave of a cathedral dome, may require a management, and an effect, very different from the ceiling of a parlour, or a dining-room: that which is ſo very diſtant from the eye, and which the ſpectator knows to be really, as well as apparently, remote from him, may be indulged in ſome peculiarities, and even in ſome liberties, of repreſentation: but, theſe form no juſtification for the introduction, or for the unwiſe treatment, of ſubjects, whoſe real diſtance from us, is but trifling, and which the eye cannot but eſtimate at little beyond arm's reach. I own, I do not like to ſee a croud of heathen deities ſprawling about—foreſhortened into thickneſſes of every form—and diſplaying, what mortals ought not to diſplay—on the ceiling of the room, where an elegant company is at dinner: if we take them for real perſonages, they ſeem ready to drop on the table; if they be mere ornamental repreſentations —would not propriety chooſe other ornaments? Theſe remarks apply to thoſe immenſe compoſitions which beload ſome ceilings, under the idea of magnificence; without cenſuring cheerful embelliſhment, ſimple ſubjects, pleaſant, agreeable, lively repreſentations, ſuch as do not imply the *gain* of a broken neck, by reaſon of the time ſpent in inſpecting them, and perhaps, miſpent in comprehending them. Let the ſubjects alſo ſuit their ſtations: celeſtial glory in a church;—but celeſtial glory is no ſubject for ſtrict perſpective: neither is an airy,

expanſive, variegated, ſky, which, with ornamental acceſſories, in moderation, may become a palace. If figures muſt be had, the lighter they are the better; and if perſpective repreſentation be indiſpenſable, let rather dexterity than rigour conduct it. We have commended the effect of retiring ſhade, but on theſe kinds of ſubjects, the beſt effects reſult from retiring light: when, in, or near, the center of the compoſition, an idea of infinite diſtance is ſuggeſted, by artful management, the effect is uſually grand, and magnificent, while it is alſo cheerful and pleaſing.

To deſcend from theſe higher regions of imagination, let us now advert to the appearances of objects much more readily offered us by nature, and much more commonly ſubjected to the exerciſe of art.

We return now, to what we have ſaid is cloſely allied to foreſhortening,—the retiring ſhadow: which may elucidate (more, I think, than is uſually ſuppoſed) the nature of *finiſhing*; finiſhing is ſimply the beſtowing on each part, or place, that tone of colour, and tint, which is proper to it. Thus, ſuppoſe the brighteſt light to be in the middle of an object; a globe, if you pleaſe; around this bright light the tint is lowered one degree, around that tint, it is lowered two degrees, then three degrees, and ſo on; retiring from the bright to the obſcure. On this principle, a man's head may be finiſhed, being rotund; not round; but roundiſh: and ſo may moſt, if not all, the members of the body; which

alſo are not round, but roundiſh: the various inflexions of the parts, catching indeed, various lights, yet not ſuperſeding the general principle of the whole, or, diſturbing the keeping of particular parts.

Keeping is, I apprehend, neither more nor leſs, than, nicely adjuſting, and repreſenting, the various tones, and tints, proper to each part; and is readily intelligible from what has been juſt delivered. Strong lights and ſhades are proper in front, and in the principal ſtations, where force is required; and weaker, gradated, and more tender colours in ſubjects meant to retire.

LADIES and GENTLEMEN, I have thus offered my ſentiments on the ſubject of PERSPECTIVE, as ſuccinctly as poſſible, and as clearly as I could: I hope I may flatter myſelf that I have been well underſtood by my auditory. The importance, the univerſality, and the conſtant recurrence, of theſe principles, have induced me to wiſh, that, they were generally promulgated, not in the ſhackles of technical terms, or of abſtruſe diſquiſition, but in eaſy leſſons, and in colloquial language. I have done my endeavour, and heartily wiſh the example may be prevalent. I am not afraid, that (as is ſaid among the faculty, if the ſimplicity of remedies were known, their efficacy would be denied) I am not afraid, that the facility of the rules I have laid down, ſhould hinder either their application, or their popularity, ſince, I think, to ſay of principles they are correct, and to add to correctneſs, ſimple and eaſy, is the higheſt panegyric of ſcientific inſtruction.

A panegyric

A panegyric on the principles of Perſpective would be a noble ſubject for the eloquence of an orator! he might ſhew its wonders in the microſcope, which renders viſible *animalcula* thouſands of times too ſmall for human viſion; he might congratulate his hearers on its utility as connected with our conſtant occupations, and our daily exigencies; he might trace its effect in the ſolar orb, and obſerve the peculiarity of the planetary ſhadows: he might demonſtrate the connection of perſpective with the azure heavens, and calculate thereby the various ſtations of the ſtellar fires; he might amaze his hearers with the diſtances of the brighteſt, and aſtoniſh them at the intervals of the paler: thoſe but diſcernible by the art of man, he might expreſs by the days, or the weeks, or the months, of their light; and might then——No, let him ſtand, rapt in reverence to that power and goodneſs, which has imparted to humanity ſuch intellectual capacity, and ſuch energetic genius!

End of the LECTURES on PERSPECTIVE.

*** To

*** To thoſe of our readers who may not have at hand a plaſter figure, proper to elucidate the principles of *foreſhortening*, we recommend the inſpection of a coach wheel, as a ſimple inſtance in point. In looking at the wheel in front, all the ſpokes ſeem equal and alike; but in an oblique view, they are greatly changed: the uprights preſerving their dimenſions, while thoſe on each ſide are apparently leſſened, in proportion to their nearneſs to the horizontal ſpokes; which are more *foreſhortened* than any others.

†‡† The peculiarity of the planetary ſhadows is, their diminution as they are prolonged; for the ſun being very ſuperior in ſize and extent, to the bodies which caſt them, the ſhadows of ſuch bodies (as of our earth for inſtance) are conſtantly converging, till, at length, they terminate in a point: ſo that the rays of the ſun are not *abſolutely* parallel among themſelves, though they be parallel to the purpoſes of perſpective.

PLATE

PLATE XLVII.

REFLECTION OF LIGHT.

Fig. 1. It is always to be underſtood that the angle of Reflection and the angle of Incidence are equal: ſo that B, A, C, is equal to C, A, D, and *vice verſa*. Wherefore if it be deſired to know where the ray B, A, when reflected from the ſurface *e*, A, *g*, will ſtrike the perpendicular object I, K, we erect from A, the perpendicular A, C, and make A, D, an angle from A, C, equal to B, A, which gives D for the point ſought.

Fig. 2. When inſtead of ſtriking an object ſituated direct, it ſtrikes on one ſituated obliquely.

Suppoſe the line of obliquity be, *e*, A, *g*, which prolong to the bottom of the perpendicular object, as at E; where erect a perpendicular line: erect alſo the perpendiculars *e*, *f*; A, C; *g*, *h*; and transfer the heights *f*, and *h*, of figure 1, to this: then, if the ray be B, *f*, A, the reflection will be A, *h*, D; being the point of interſection with the line E. D. The re-reflection follows the ſame law.

Fig. 3. Exhibits the ſame principles, further applied to ſundry ſubjects. B, A, is a ray of light, which falling on this ſide the ſhadow of the board, produces no effect; becauſe its reflection, A, D, is ſpent in air; but *b*, *a*, by its reflection *a*, *d*, ſtriking the corner of the board at *d*, very much enlightens that under ſurface, which elſe would be altogether in ſhadow: and as all following rays advancing toward I, would be reflected further on the ſhadow, it follows, that the whole courſe of this edge of the board will be enlightened, by ſuch reflections. Now if the ground A, *a*, I, be ſuppoſed green, the light reflected from it, will render the under part of the board greeniſh; if it be red, the reflection will be reddiſh: and ſo of any other colour.

Fig. 4. But beſide the reflections which from the ground may ſtrike upon any object, reflections from objects may (*e contra*) ſtrike upon the ground. As for inſtance; though no ray of light can paſs through the ſtone, B, *o*, X, (whereby the whole ſurface from X to A, is kept in ſhadow) yet from B to A, all may paſs freely; and ſo from A to D. By the ſame rule it will follow, that a ray of light E, D, may paſs by reflection to A, and ſo to B; now though ſuch a ray would have no effect on any ſhadowed part, yet a ray to M would be reflected to N, and ſo to *o*; of conſequence, all the rays falling between D, and M, would be reflected on the ſpace between A and N; thereby enlightening it very conſiderably; while the part from N to X remains dark, being viſited by no reflections. As theſe ſtones are not parallel but oblique to each other, the ſhadow of the ſtone B, *e*, *l*, X, is deſcribed by the lines A, *t*, *c*; ſo that a portion of the further end of the ſhadow *t*, *c*, 2; and 2, *u*, *t*, will alſo be without reflections, and conſequently dark. It is true, that in nature, this ſhadow would be nothing near ſo viſible as here repreſented; becauſe a variety of rays of light diſperſed in the atmoſphere, or reflected from various parts, would confuſe it by their mingling among it. It would alſo be further ſoftened by the principles of KEEPING.

PLATE

PLATE XLVIII.

KEEPING. PLATE I.

Keeping conſiſts in giving to each part that tone of color, and ſtrength of light, or ſhadow, which is its due: its purpoſe is, by means of making ſome parts ſeem to recede, to make others, by compariſon, appear to advance. As to tone of color, we relinquiſh that here: but as to gradation of light and ſhadow, we have thought a few examples might be uſeful. For this purpoſe,

Fig. 1. The upper figure ſhews a number of cubes, the light coming on one ſide; theſe preſerve their diſtance, and effect, by the influence of the air, but they differ in appearance from columns: becauſe in the circumference of a column no two parts are preciſely at equal diſtance from the eye; but if we take the neareſt point in the circumference, all other points are further, or if we take the furtheſt, all other points are nearer; but in ſquare bodies this is not the fact; the whole front ſurface being directly oppoſed to the eye, and equally diſtant from it. Hence ariſes the flatneſs of its appearance; and the no-reflection of its face, ſo ſituated. Nevertheleſs, the further parts of a face obliquely ſituated, are affected by reflection; and, if light, are darkened; if dark, are lightened; by which they ſeem to recede from the eye.

Fig. 2. Exhibits the ſame objects, with the light coming on them in front: now as we ſee objects, only by means of the light they reflect to our eye; we may expect in this ſituation of the light that it will be reflected from theſe objects to us with the greateſt vivacity; becauſe moſt direct: the light then from theſe ſquares will be moſt ſprightly and vivid, but it will alſo obey the ſame laws, in reſpect to diſtance and keeping, as regulated the figures above.

PLATE

PLATE XLIX.

KEEPING. PLATE II.

Repreſents in its upper figure a number of cylinders, the light coming from behind them toward the ſpectator; on which we remark that the further objects are leaſt diſtinct, leaſt ſtrongly enlightened, and leaſt ſtrongly ſhadowed: whence they communicate the idea of diſtance. The reaſons are evident: (1.) They are diminiſhed in ſize, therefore occupy leaſt ſpace on the retina. (2.) The light reflected from them has a further diſtance to paſs through to the eye than that reflected from the front objects; and, if this paſſage be through a denſe medium, in proportion to ſuch denſity, will be the feeble effect produced by the light ſo reflected from them. (3.) This muſt be referred, not only to the enfeebled powers of the light, but alſo to thoſe of the ſhadow, inſomuch that in the ſame proportion as the lights are obſcured, the ſhades are enlightened, approaching toward the color of the air, and in conſequence, theſe diſtant objects appear unequal in brilliancy and vivacity to thoſe which are nearer the eye.

The lower figure exhibits the ſame objects, with the light coming ſideways upon them; whereby they are conſiderably more enlightened, and a greater breadth is obtained; but they continue to appear either to recede, or to advance, on the ſame principles as before. Theſe figures being round objects, their roundneſs produces a kind of ſhade on their enlightened ſides, cauſed by the obliquity of the rays of light reflected from them: as on their darkened ſides, their roundneſs produces a kind of enlightening, which is occaſioned by the admixture of light reflected from around, on theſe parts; which, debaſing as it were, the ſhadow, ſoftens it into ſomewhat of lightneſs.

PLATE L.

KEEPING. Plate III.

Though we ſaid before, in order to render more ſenſible the difference between round and ſquare bodies, that the whole ſurface of a ſquare oppoſed to the eye is uniform, and flat; yet this muſt not be ſo ſtrictly taken, as if in plane ſurfaces of conſiderable extent, all parts affected the eye alike. Suppoſe the eye O, to ſurvey the vertical plane before it: it will receive a true and perfect image only of that part which reflects the direct ray O, 1, whoſe plan is A. B: this line it examines perfectly (eſpecially in the center 1, leſs in the point 2, leſs ſtill in the point 3): but the line O, 5, 4, whoſe plan is A, 4, being oblique from the direct ray, loſes force in proportion to the quantity of its obliquity; as appears yet more ſtrongly by the line O, 7, 3, whoſe plan is A, *b*; for the angle made with the direct ray by this line, being very large, it can depict on the retina of the eye O, only an imperfect glimmering.

Fig. 2. If the effect of oblique lines in regard to the ſame plane be ſo conſiderable, when that plane is directly oppoſed to the eye, the effect of planes oblique to the eye, and ſtill more, of oblique lines deflected to the eye from oblique planes, muſt be very conſiderable indeed. To render this more ſenſible, in this figure ſeveral planes are beheld by the eye O: the plane, 1, is direct to it; but the plane above it 2, is oblique; and ſo is the horizontal plane 3, 4; and the ceiling 5; it will follow—that of theſe planes, the plane 1, will make the moſt vigorous impreſſion on the eye, and indeed, will be the only one perfectly ſeen by the eye.

To illuſtrate this yet further, ſuppoſe that each ray from the eye ſhot a little ball againſt theſe planes, and that ſuch little ball rebounded from them; in ſuch caſe, the ball 1, being ſhot direct, would rebound direct, and return along the line 1, O, but the other balls would rebound according to their angle of incidence: O, 2, O, 3, O, 4, O, 5, and would fly off ſtill further from O. If theſe balls were ſhot with deſign to ſtrike forcibly, and to damage the ſtone where they ſtruck, only the ball O, 1, would produce its full effect; the obliquity of the others depriving them of half, or more than half, their power; from whence we may eaſily conceive the diminiſhed reaction of theſe reſpective points on the eye O, which ſees them only by the light they deflect to it.

PLATE LI.

KEEPING. PLATE IV.

The upper figure illuſtrates the ſame principle as the former plate, but in relation to round bodies: for ſuch a body may be conceived of, as formed by a number of planes in various directions. In this caſe, the point 1, anſwers to a vertical plane, and the ray O, 1, will have the ſtrongeſt effect either from the eye O, on the point 1, or, *vice verſa*, from the point 1, on the eye O: for all the other rays are weakened by their obliquity, O 2, and O 3, will be ſtronger than O 4: O 5, O 6, O 7, will be enfeebled indeed, inſomuch, that if the back ground to theſe points was adjuſted to them, in color, &c. the eye would not be able to determine the courſe of the outline.

Fig. 2. Endeavours to realize the principles of AERIAL PERSPECTIVE, by ſuppoſing the eye O, to inſpect ſix ſticks placed conveniently before it at different diſtances, and ſeen by it through different media. If the air was perfectly clear (which it never is) the difference between the firſt ſtick and the ſixth might be inconſiderable; and only referred to its diminution in ſize: but if the air was vaporated to the denſity of A, the eye O, might be able to ſee the ſixth ſtick but faintly; if the air was vaporated to the denſity of B, No. 6, might become inviſible; and No. 5, only be diſcerned. By the ſame rule, at the denſity C, No. 4, would be the limit of ſight; and ſo on, till at the denſity *e*, the ſtick No. 1, or at moſt No. 2, would be viſible.

This ſubject may alſo be thus explained: an object ſeen through a ſmaller quantity of medium (ſuppoſing now the medium to be of uniform denſity) is more diſtinct than another object ſeen through a greater quantity of the ſame medium: thus, if at the diſtance O 1, the power of the medium to obſcure a ſtick be as A, at the diſtance O 2, it increaſes to B; at O 3 to C; and ſo on. So that if theſe diſtances be ſuppoſed extenſive, no wonder that at the diſtance 6, the quantity of medium equals in power of obſcuration the tint E. From this principle ariſes the whiteneſs of the ſky next the horizon, the blueneſs of diſtant mountains, and the diſtant gradations of landſcape.

END OF THE LECTURES ON PERSPECTIVE.

PRINCIPLES

LECTURES

ON THE

POLITE ARTS.

THE SECOND SERIES.

Delightful task! to rear the tender thought,—
To teach the young idea how to shoot;
To pour the enlivening spirit, and to plant
The generous purpose in the glowing breast.

ORDER

OF THE

LECTURES IN VOLUME II.

PERSPECTIVE.

ARCHITECTURE.

LIST OF PLATES

BELONGING TO

THIS VOLUME.

PERSPECTIVE.

Plates to Lecture I.

Plates to Lecture II.

Plates to Lecture III.

Plate

Plates to Lecture IV.

ARCHITECTURE.

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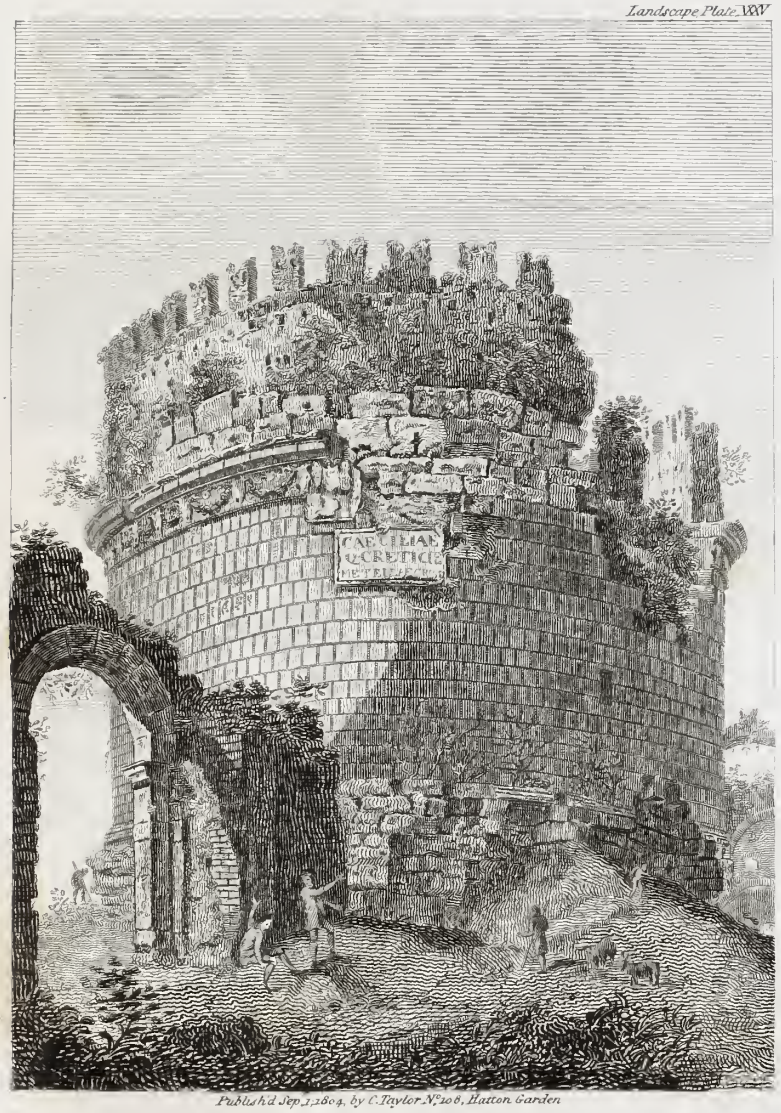
View of the LAVA of MOUNT VESUVIUS in its Course. A.D. 1751.



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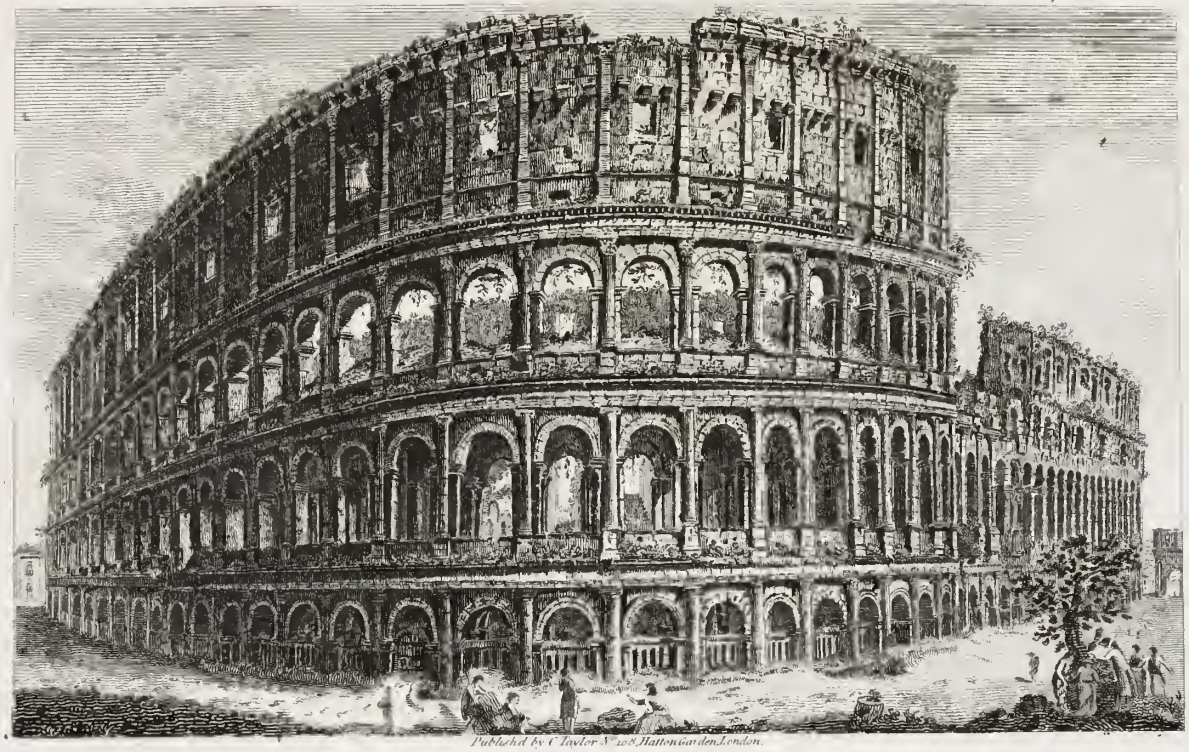

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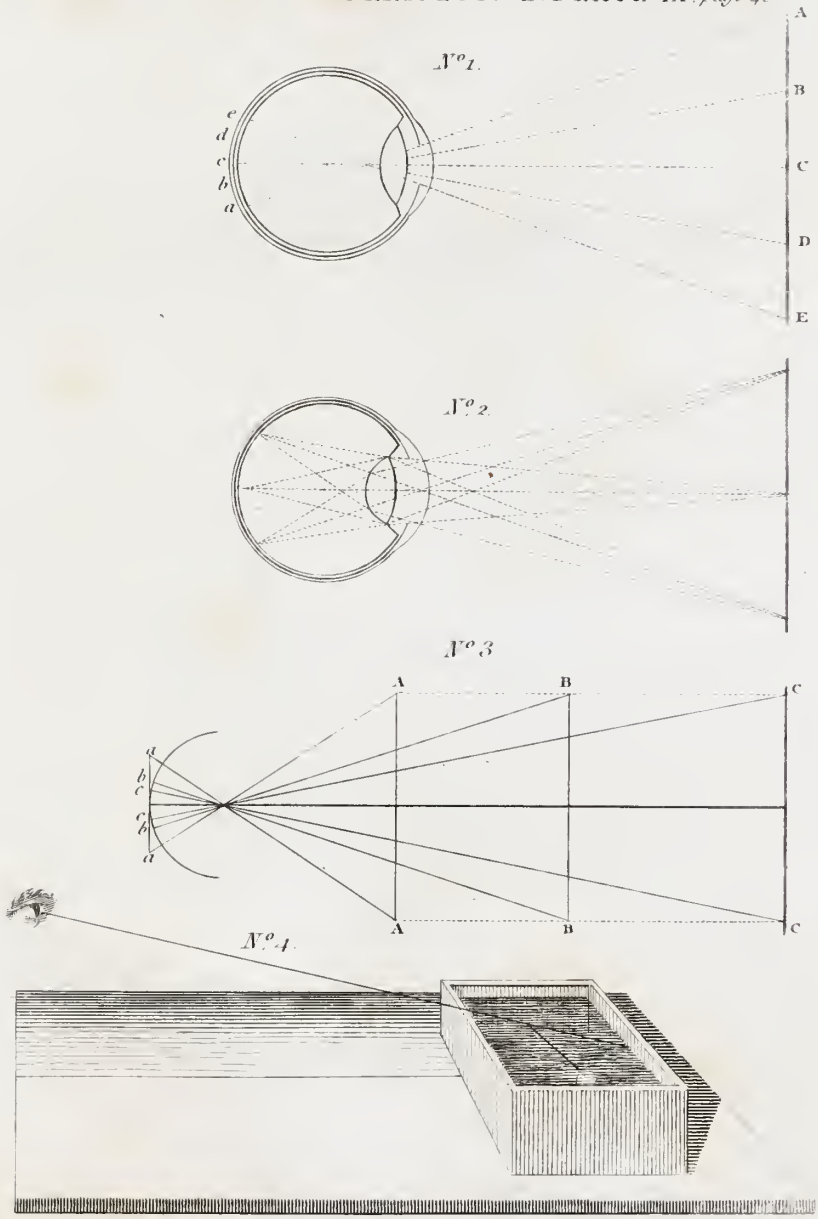
Landscape Plate XLIII.

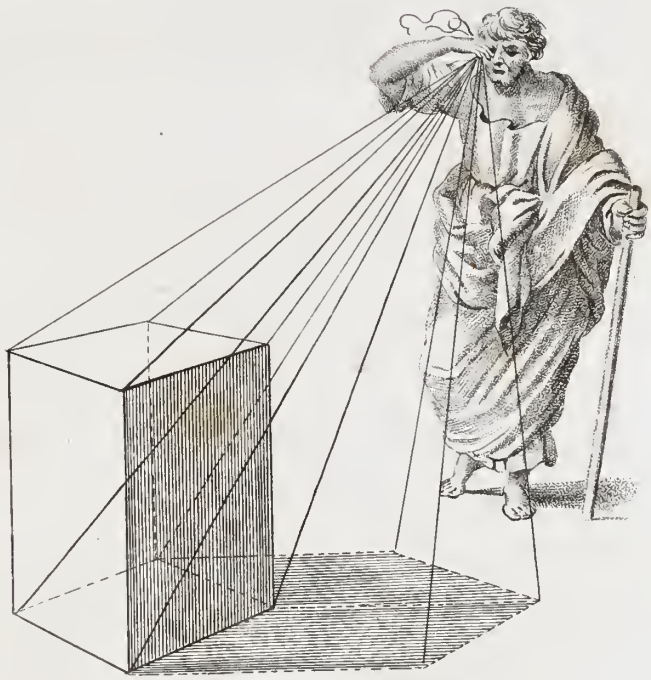
Landscape Plate XLIV

PRINCIPLES
of LANDSCAPE.
To be Drawn with a Pen.

To be Drawn with a Pen.

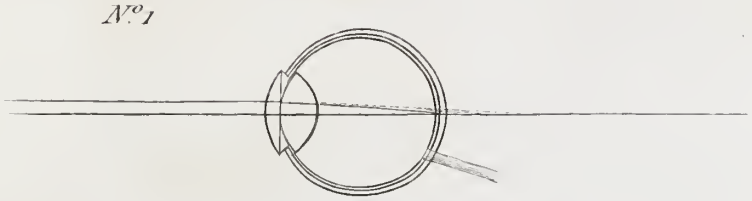
PERSPECTIVE. PLATE IX. *page 42*





PERSPECTIVE. PLATE XI. *page 44.*

N.o 1



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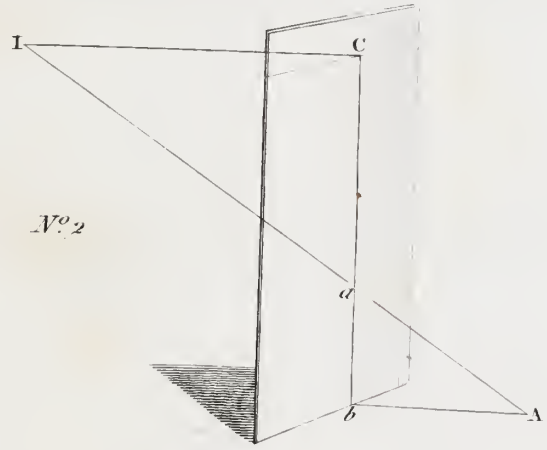

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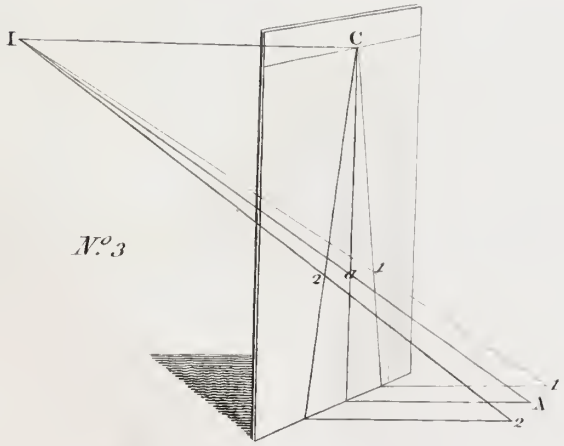

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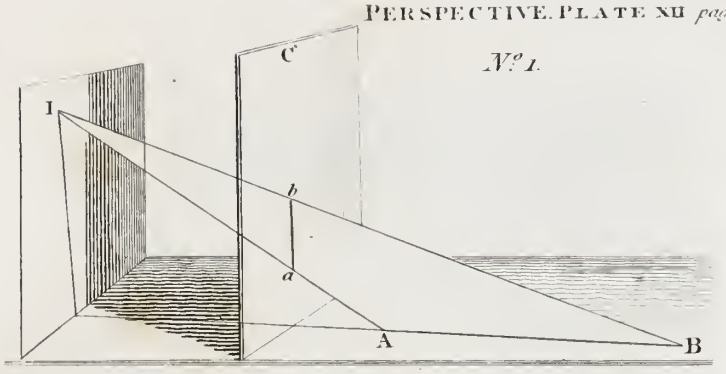

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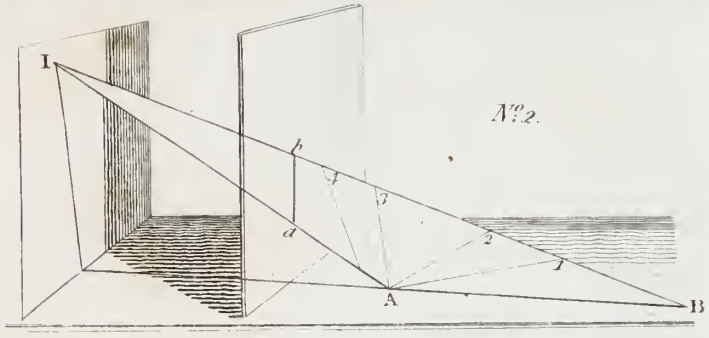

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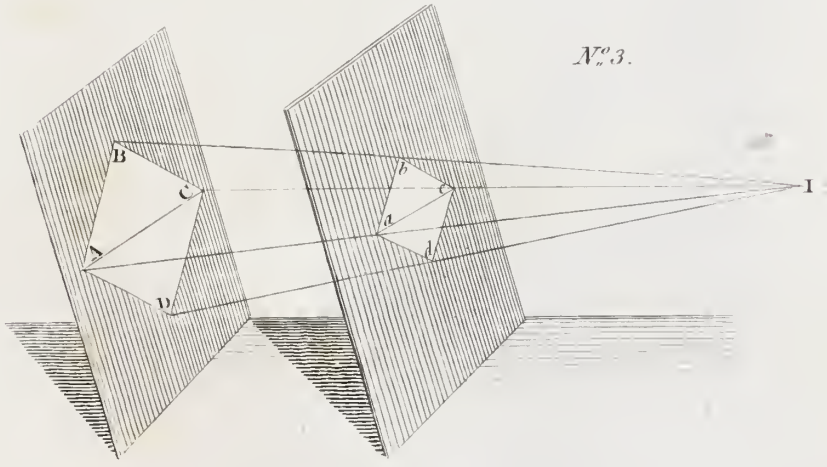
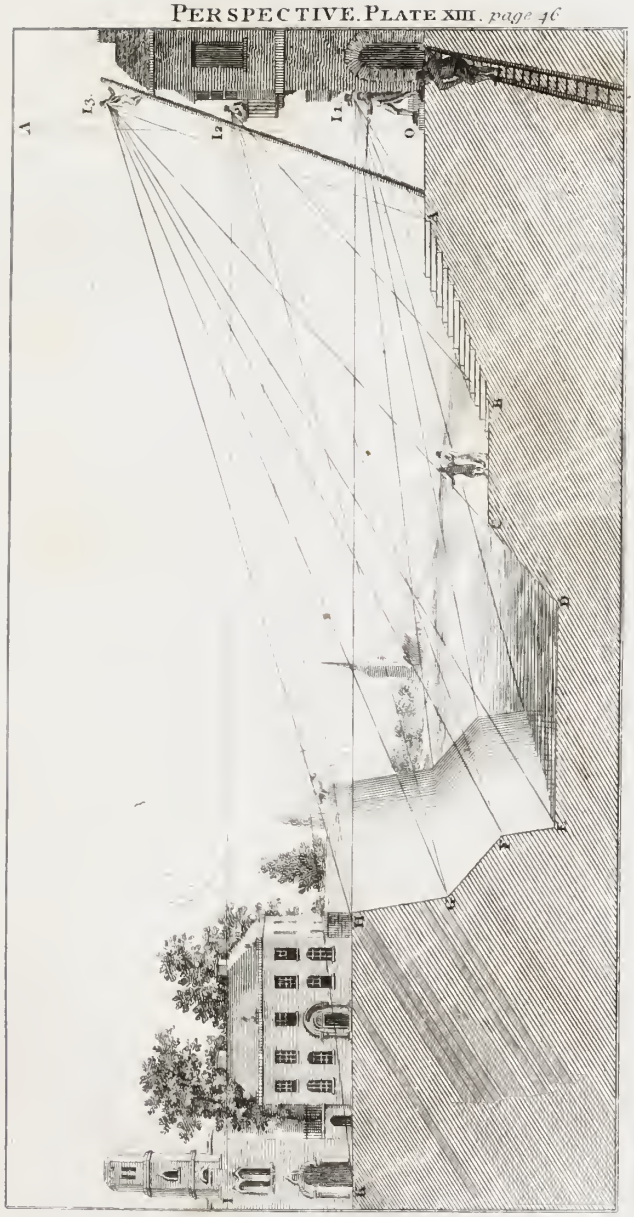
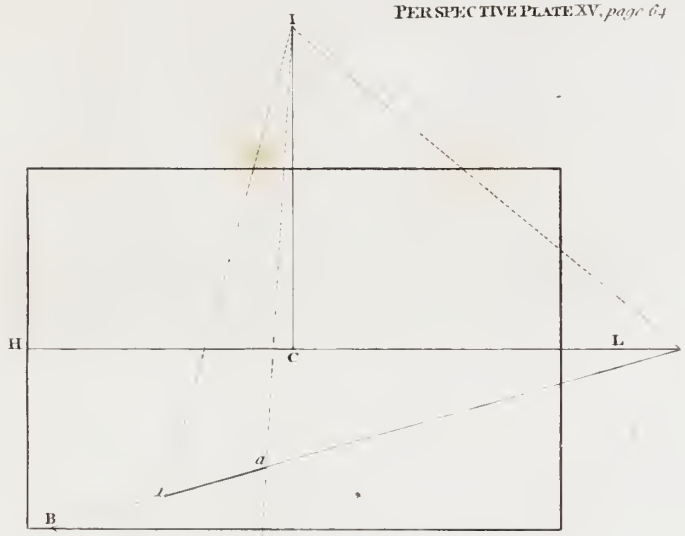


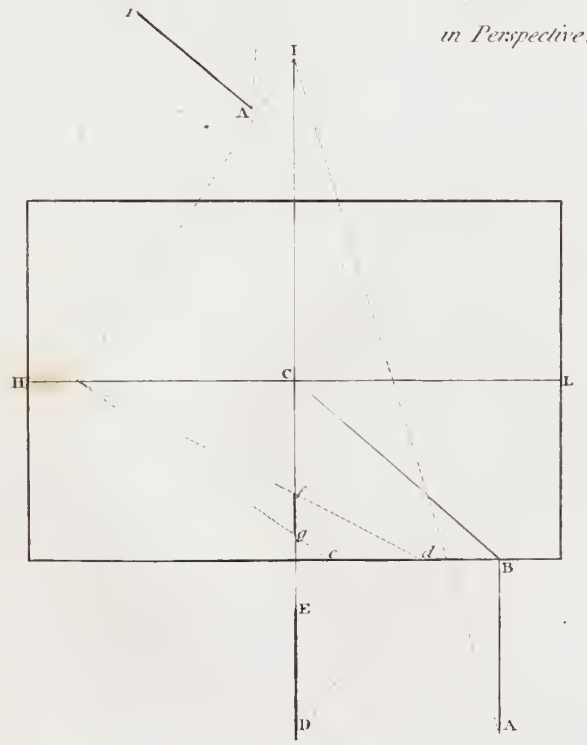
PERSPECTIVE. PLATE XIII. *page 46*

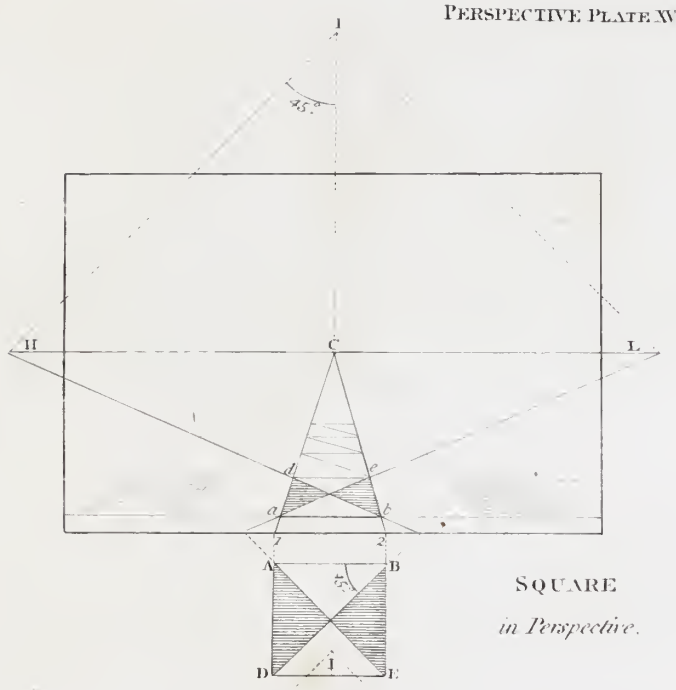




LINES

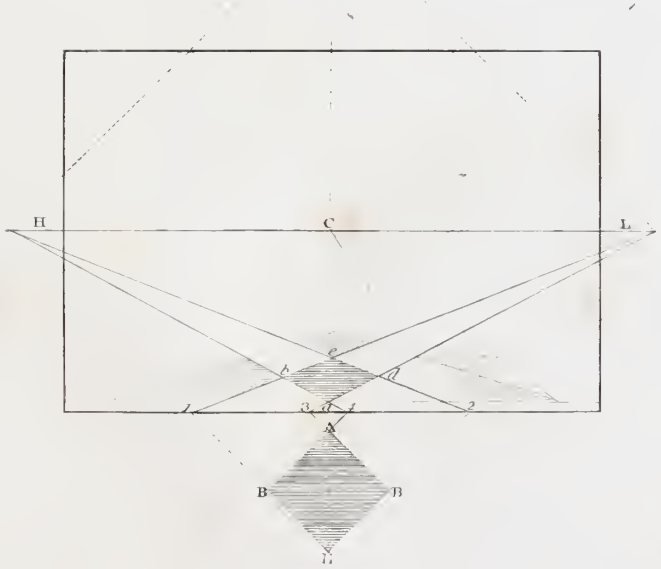
in Perspective.

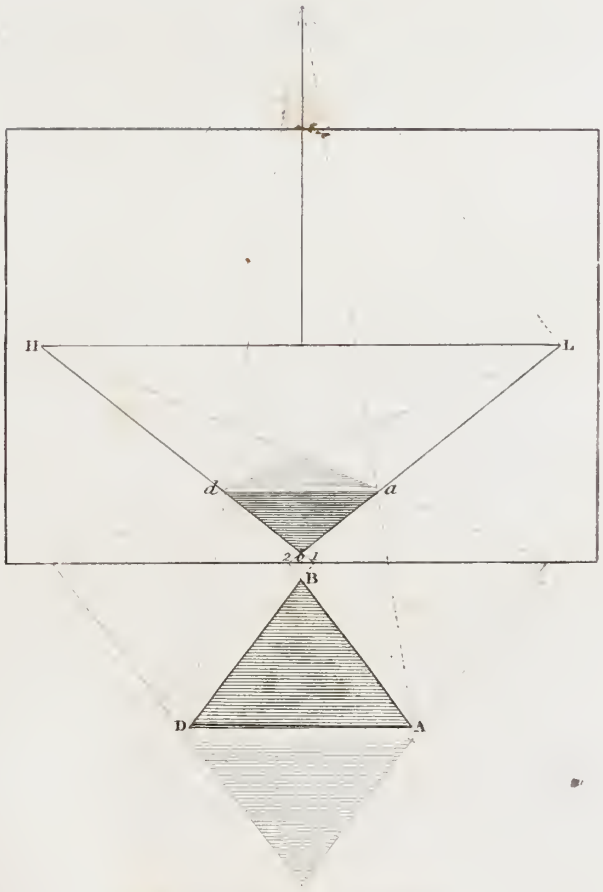




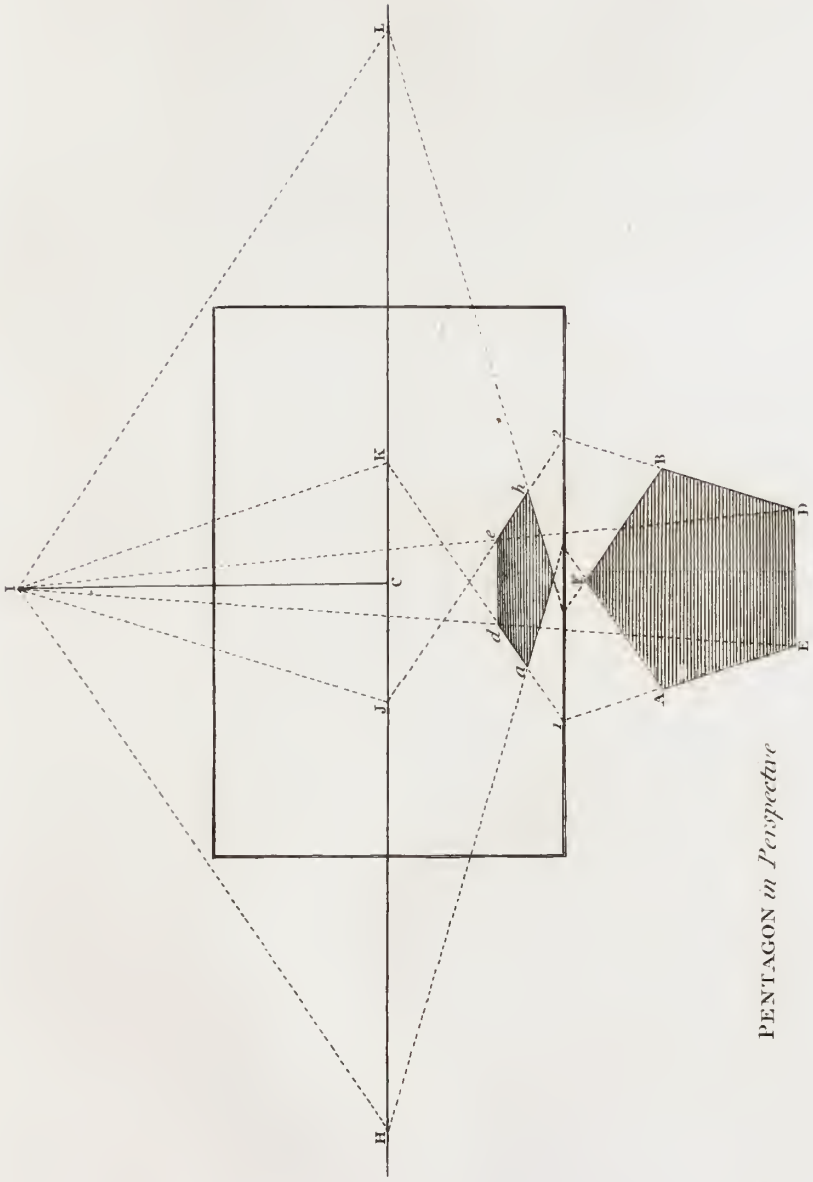
SQUARE

in Perspective.

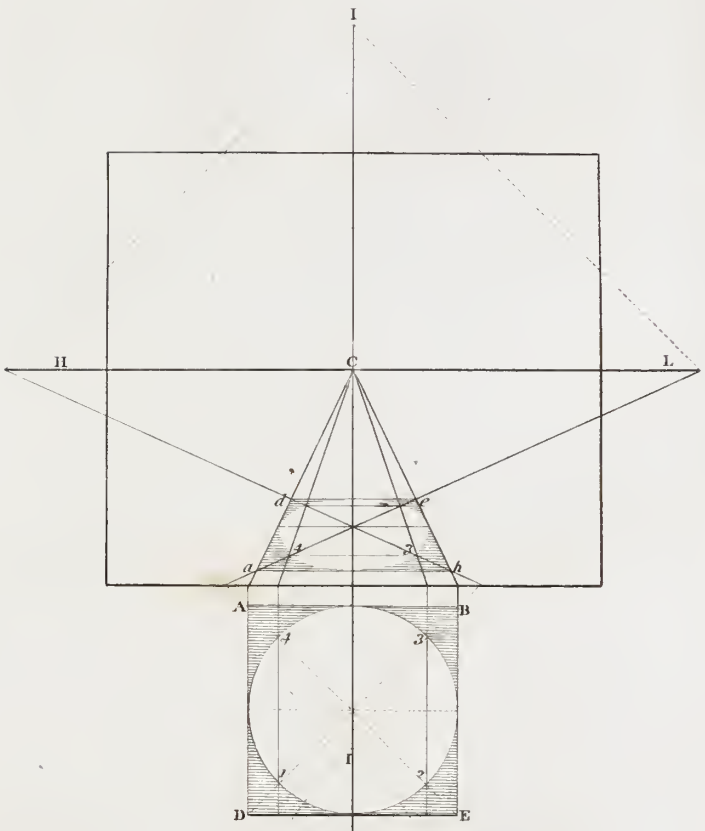




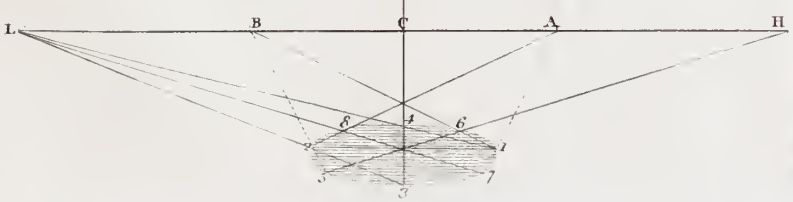
TRIANGLE *in Perspective*

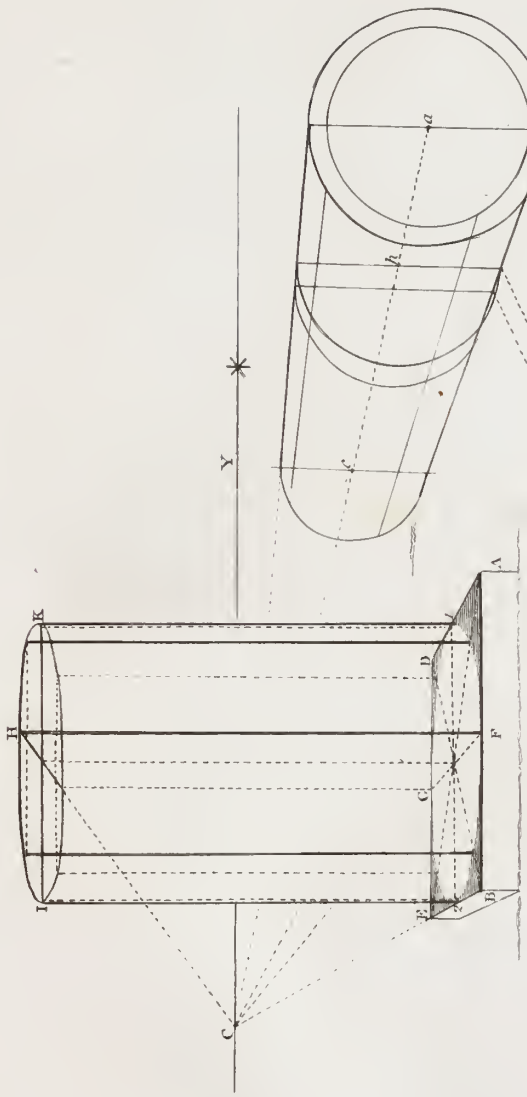


PENTAGON *in Perspective*

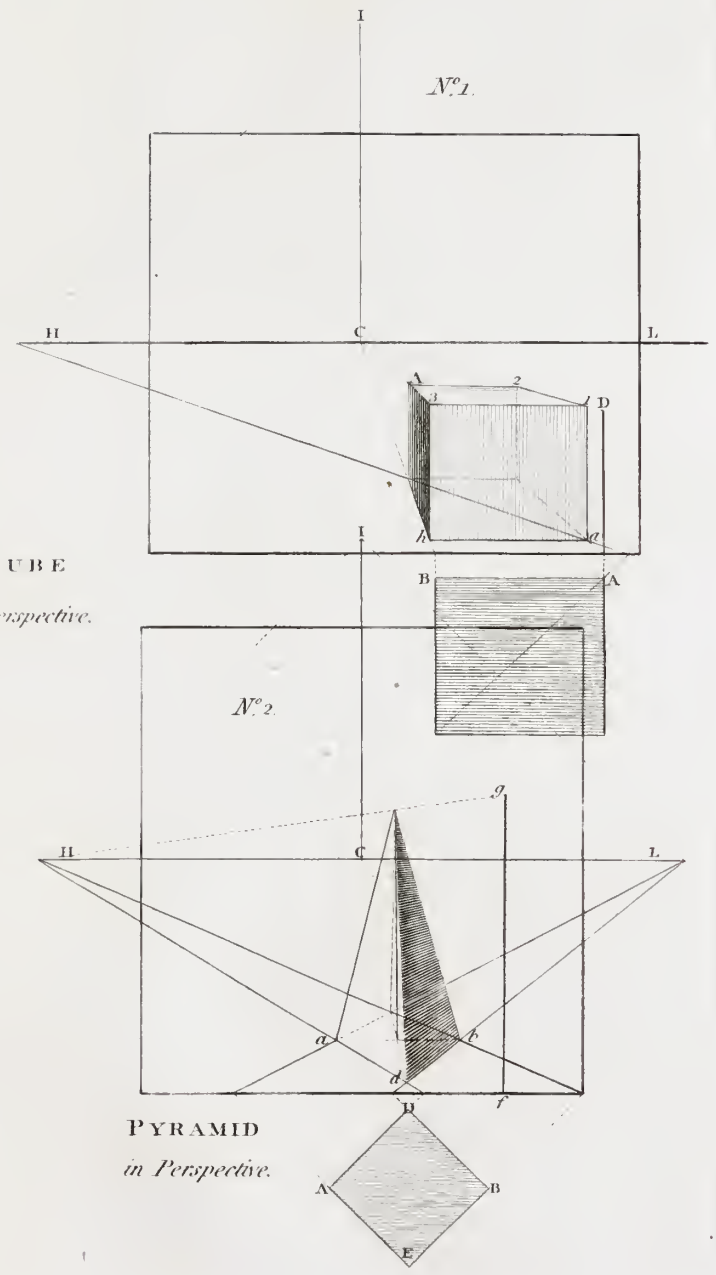


CIRCLES *in Perspective.*





CYLINDER *in Perspective.*

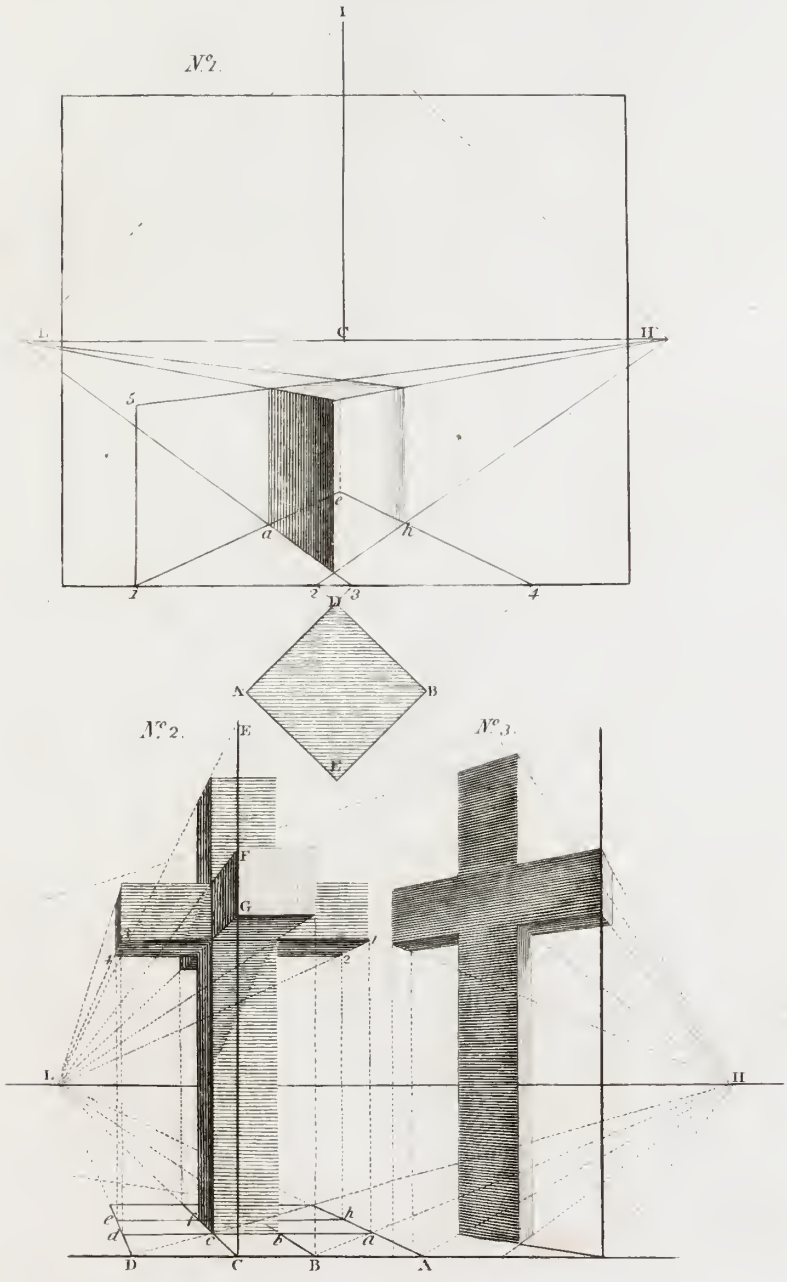


CUBE

in Perspective.

PYRAMID

in Perspective.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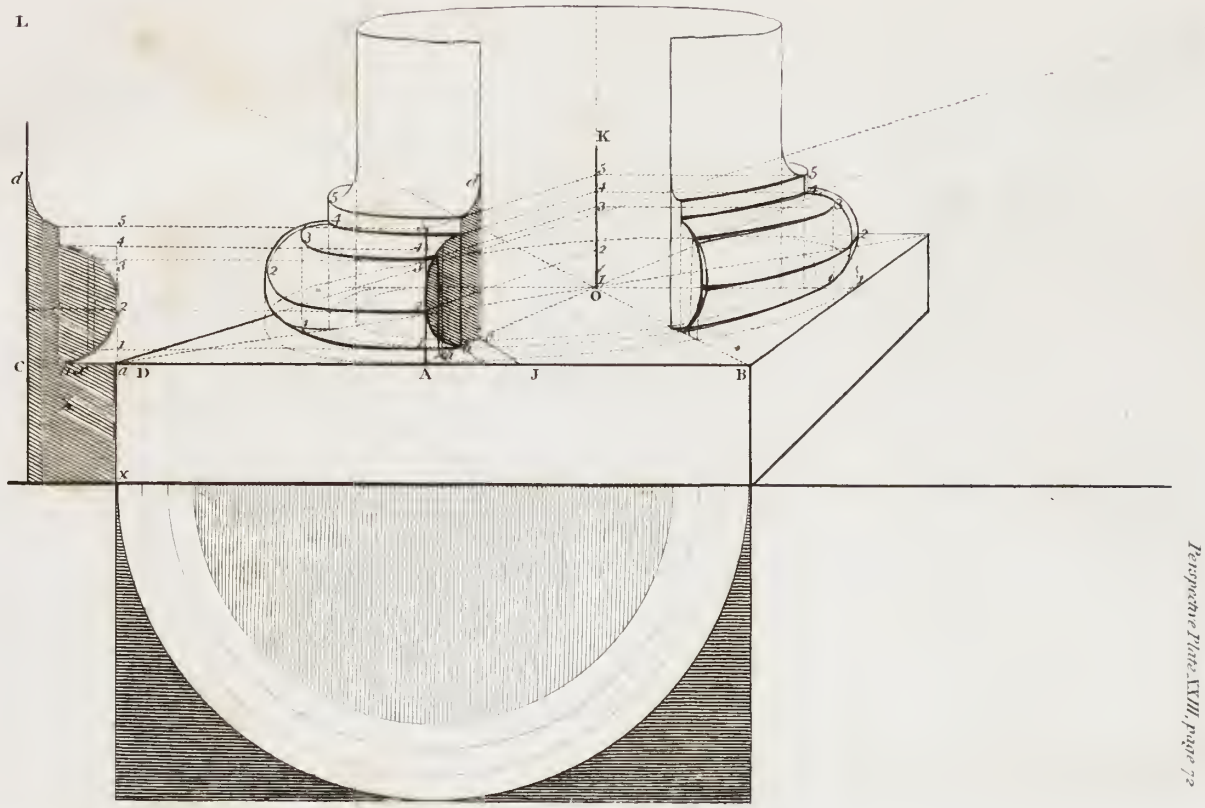
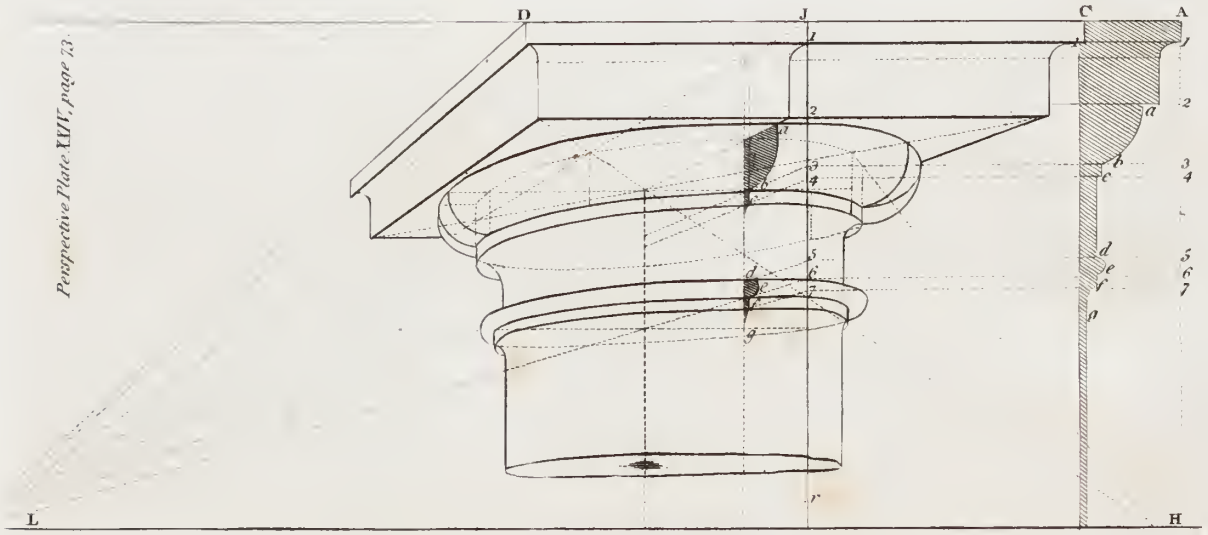
TUSCAN BASE, in PERSPECTIVE



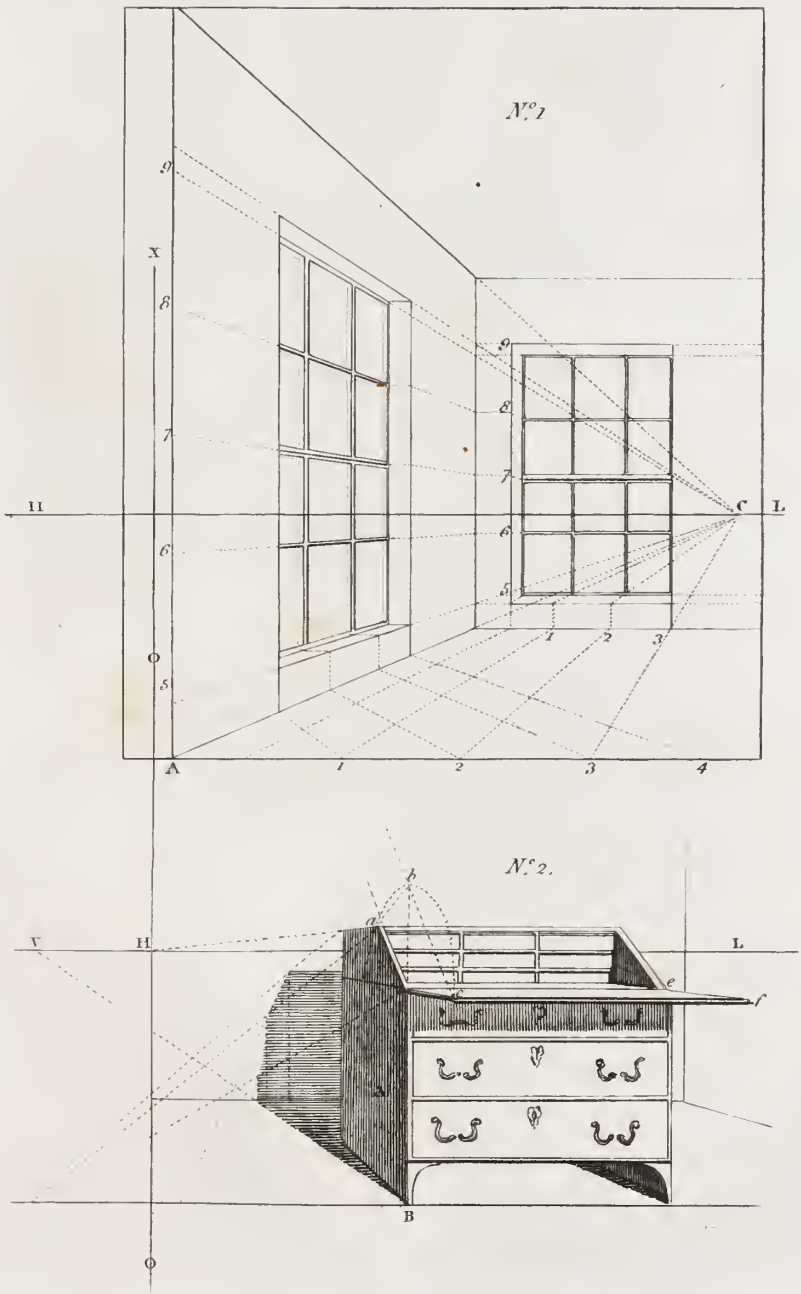
Perspective Plate XVIII, page 72

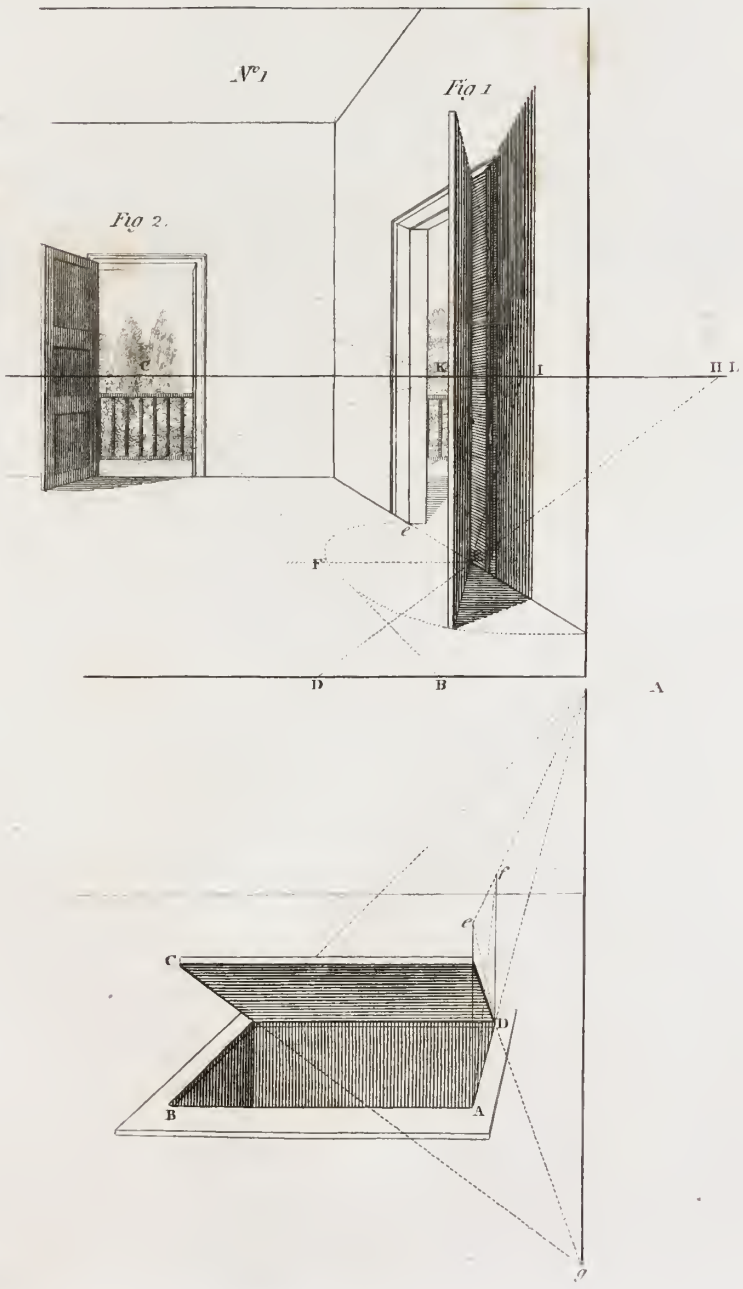
TUSCAN CAPITAL in PERSPECTIVE



Perspective Plate XVII, page 73.

PERSPECTIVE PLATE XXV, *page 74*

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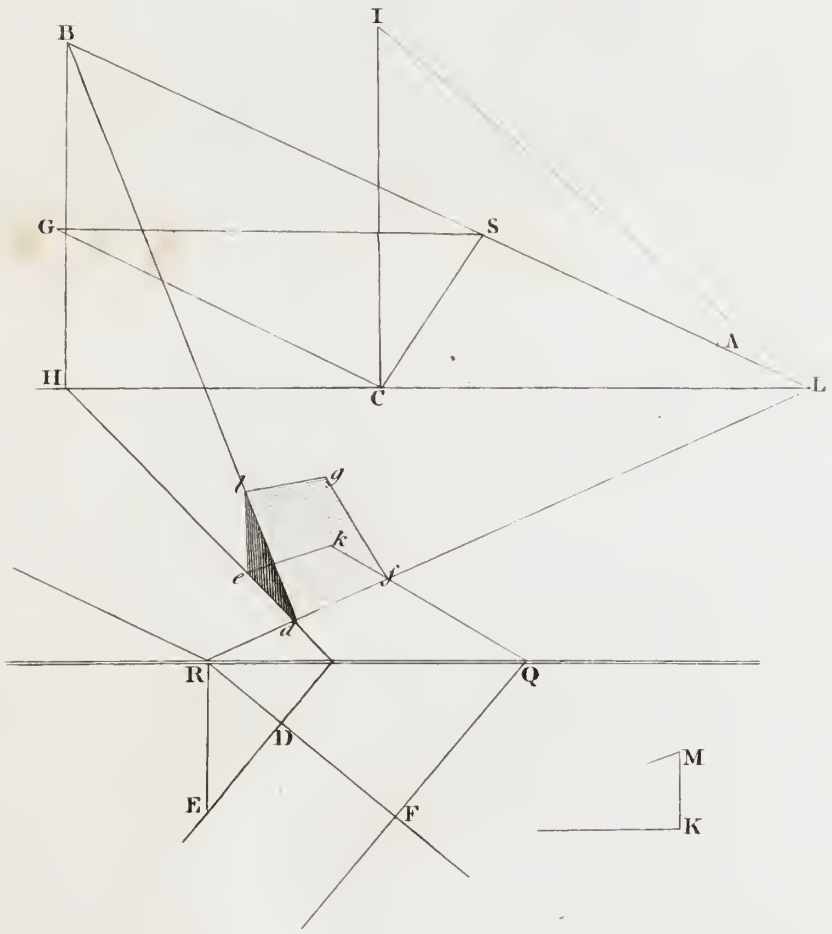
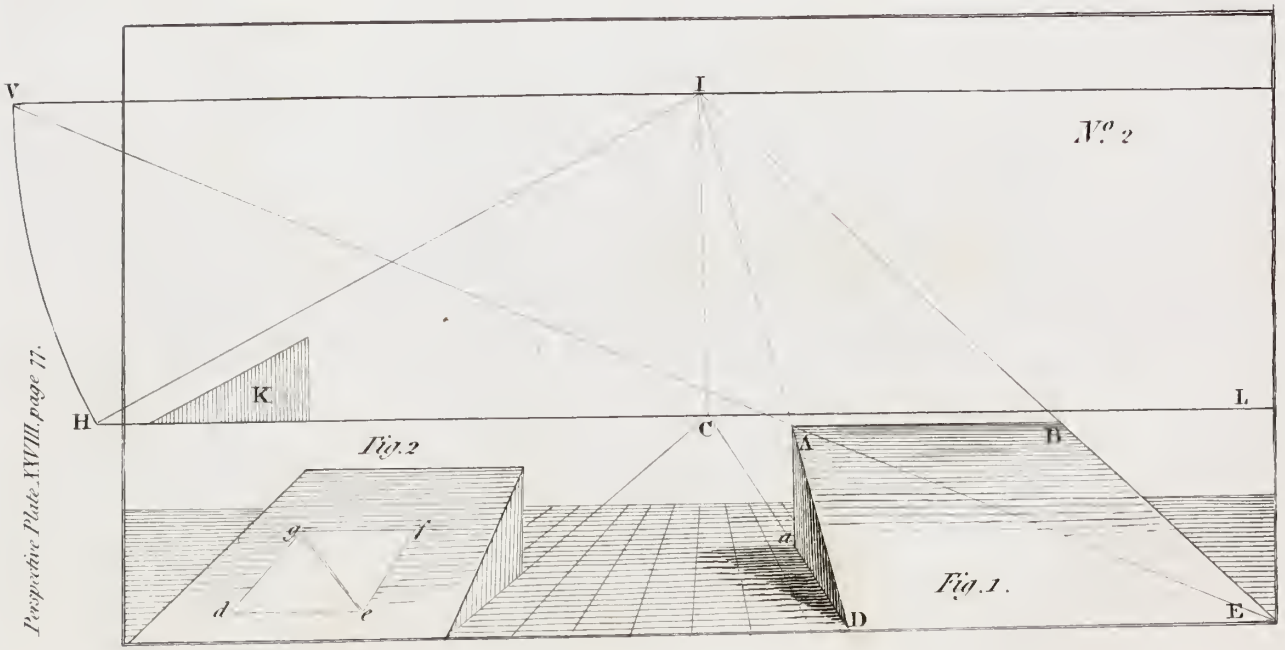
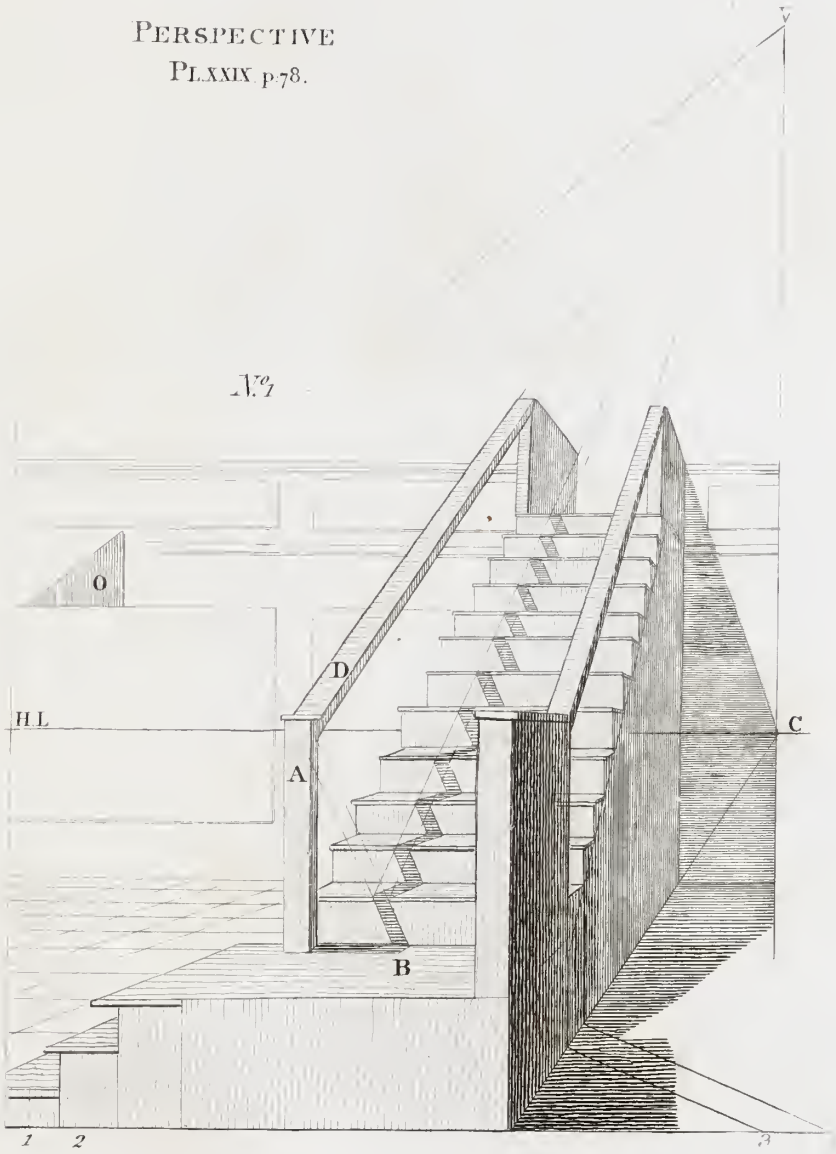


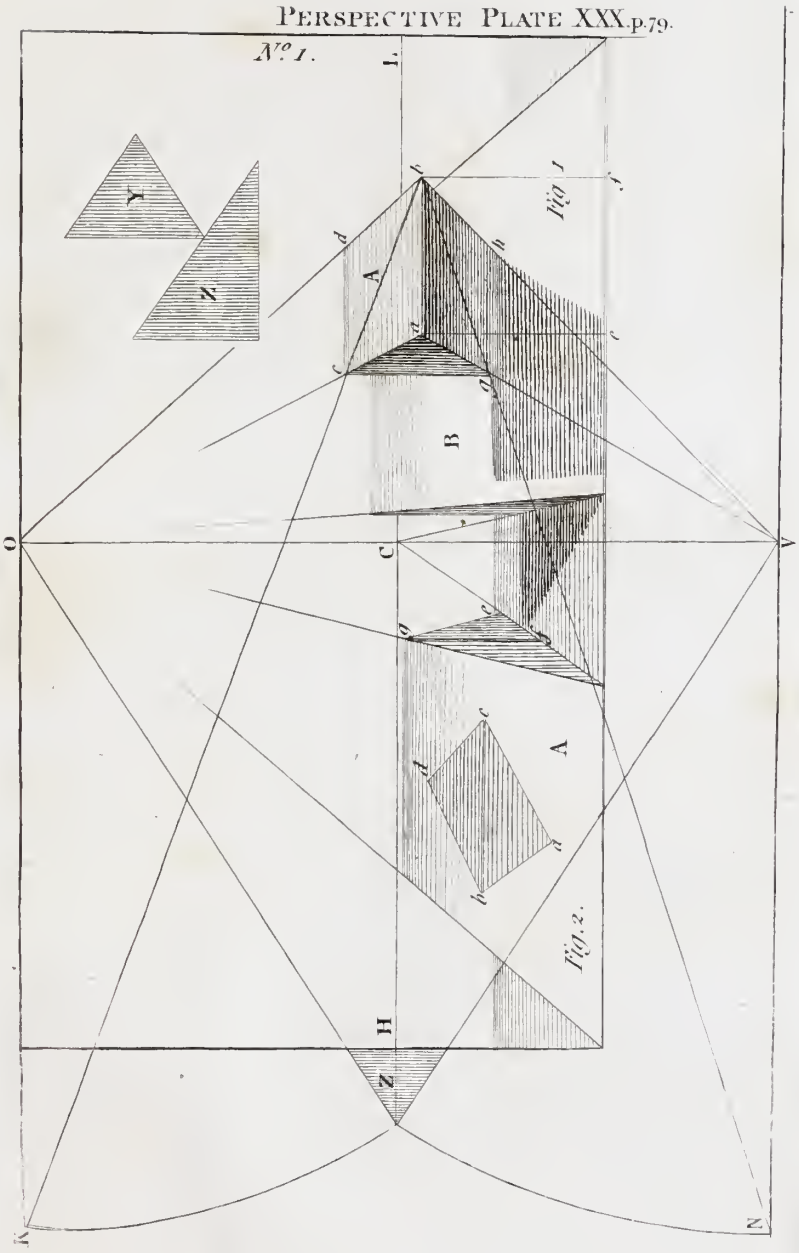


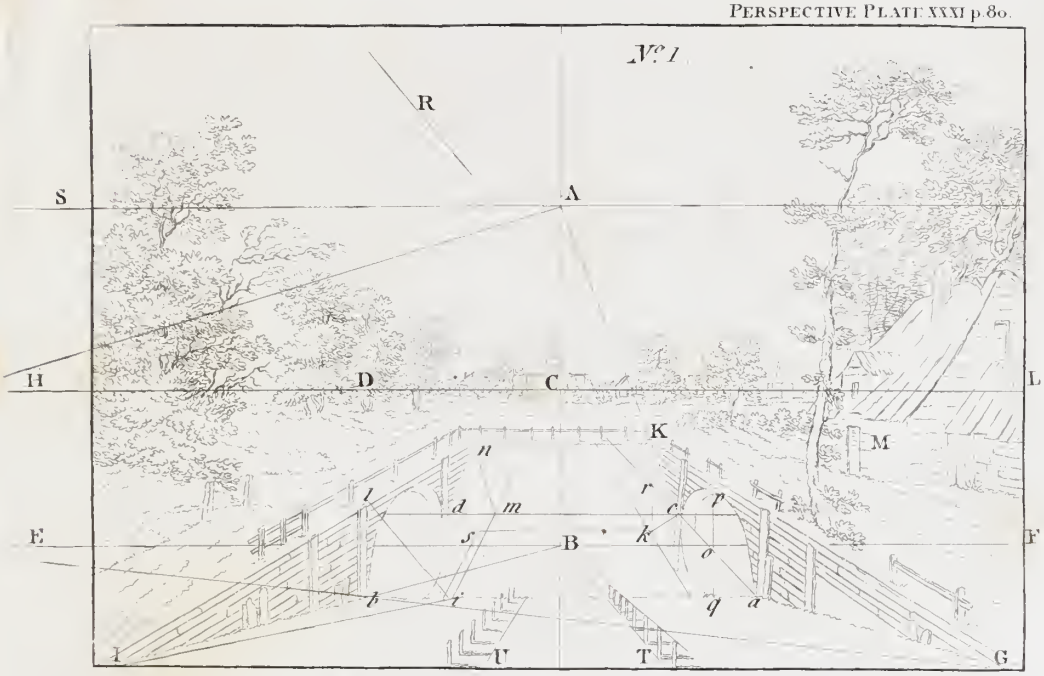
Perspective Plate XVIII. page 77.

PERSPECTIVE
PL.XXIX p.78.



PERSPECTIVE PLATE XXX. p. 79.

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